THURSDAY, MARCH 16, 1882

ARISTOTLE ON THE PARTS OF ANIMALS

Aristotle on the Parts of Animals. Translated, with Introduction and Notes, by W. Ogle, M.A., M.D., F.R.C.P., sometime Fellow of Corpus Christi College, Oxford. (London: Kegan Paul and Co., 1882.)

THE translator and commentator of this learned work, in speaking of the many erroneous statements in the text of the master, tells us we have only to remember the strange vicissitudes to which the original manuscripts of Aristotle's treatises are said to have been subjected, to obtain a fair reason for the occurrence of these errors. "Hidden under ground in the little town of Scepsis, to save them from the hands of the kings of Pergamus, who were then collecting books to found their famous library, and who, in so doing, apparently paid but little regard to the rights of individual owners, they were left for the better part of two centuries to moulder in the damp, 'Blattarum et tinearum epulæ'; and when they were at last brought to light fell into the hands of Apellicon of Teos, a man who, as Strabo says, was a lover of books rather than a philosopher, and who felt no scruple in correcting what had become worm-eaten, and supplying what was defective or illegible."

In putting this explanation of the errors found in the works of Aristotle before his readers Dr. Ogle seems to have ignored another explanation, which has also been supported, namely, that Aristotle himself intentionally rendered some parts of his treatises obscure. Certain of our English classics have quoted or referred to the correspondence reported to have occurred between Alexander the Great and Aristotle. Alexander having heard, while he was in Asia, that the books of his master were exposed to public sale, is reported to have expressed himself as extremely disgusted that such profound knowledge was laid open and made plain to common understandings, and wrote to the master urging this complaint, and that when the doctrines and precepts communicated by him in private were spread over the world, he should have no wisdom to boast of above the meanest of his subjects. To this Aristotle is said artfully to have replied that he had indeed exposed his works to public sale, but had cast such a veil over them that not one eye in a thousand would be able to discover what lies concealed under them. It had, we think, been fortunate for Aristotle if the mystery made to surround his works had been confined to the little town of Scepsis, and if the many prevarications in respect to them had been confined to the hands of Apellicon, of Teos. For, until recently, it has happened that Aristotle generally has been read and written upon by lovers of books rather than philosophers, and that he has, consequently, been misrepresented high and low, far and wide. Of Aristotle indeed it may be said as Antony said of Cæsar—

> The evil that men do lives after them;
> The good is oft interred with their bones.

He is much more remembered by the masses from the infirmities which are attributed to his career, than from the details of his work. The picture of his personal appearance and manner, his effeminate voice, small eyes, spindle shanks, love of dress; his withdrawal from the Academy; the treatment of him by Plato as a truant and fugitive, who, like an insolent chicken, pecked at his mother hen; his bluntness and supposed discourtesy to his pupil Alexander; his retirement to the court of Hermias, and his assumed intrigues with that tyrant; his marriage with the sister or concubine of the tyrant, and the absurd homage he is declared to have paid to the woman of his admiration; these are all topics which, true or false, have floated down and connected themselves closely in the popular mind with Aristotle as a man living a strange life rather than as a philosopher living a life of philosophy.

They who, irrespective of all these reflections, have tried to read this master from himself, and, with singleness of mind, to understand him in his greatness, will feel no little delight in studying the volume which Dr. Ogle, with learned love for his theme and its author, has put before the world, and for which all scientific men will feel deeply obligated. It is not only that in 140 pages of fine English he has translated this work of Aristotle "On the Parts of Animals," but that he has also written an "Introduction" of thirty-three pages, which prepares the mind of every student for the reception of what is to follow, and has added 111 pages of closely-printed matter, containing notes of an explanatory kind bearing upon all the doubts and difficulties of the text.

The introduction to the work brings before us the mind of Aristotle in respect to his ideas of the origin of created things. In his period, as in ours, there were two schools of philosophical reasoners on beginnings. There was a school which fancied it had found an adequate cause for the phenomena in the necessary operations of the inherent properties of matter. There was another school which discovered a solution in the intelligent action of a benevolent or foreseeing agent which they called God or Nature. Between these opposite views, says our author, Aristotle had to decide, and he decided for neither exclusively, but for both, although in very unequal degrees. "The motions of the heavenly bodies are governed by necessity and by necessity alone. But in the works of nature, that is, in the phenomena of terrestrial life, this necessity is a comparatively unimportant factor." Most is the outcome of design. Still some part, though but a small one, is the result of necessity. There is indeed one sense in which everything in the animal body may be said to be the result of necessity. When a man builds a house, he must, in order to realise his plan, of necessity have walls, roof, and the like. To have these he must first have bricks, stones, mortar, and what not; and again, to furnish these, clay, lime, and the other necessary materials. So it is with the animal body. The design of nature cannot be carried on without the necessary antecedents. In this sense then all parts of the body, and all the successive stages by which they are developed, one after the other, may be said to be the result of necessity, for all must necessarily be there if the plan of nature is to be realised.

From the materialists, however, Aristotle is shown to differ. They contended "that organisms are evolved as necessary consequences of the inherent properties of matter." This Aristotle admitted and disputed. In some measure he considered that what they said was true, but that measure is small; for nature, in making plants and animals, can but use such material substances as exist; she does the best she can with the materials that are at hand, but the properties of those materials are beyond her control, and such consequences as follow upon those properties are the results of necessity.

Dr. Ogle, describing this view of his author, refers to the singular reference which Galen long after made to the same view, and to the criticism Galen offers on the Mosaic tradition of the creation, a work he had evidently read with much care. Galen disputes with Moses on the point that the Creator can make an animal of any matter he chooses—a man from a stone, an ox from dust. "This," says Galen, "we deny. The laws of matter are antecedent to the Creator, and obligatory upon Him."

Aristotle in his teaching was as little Agnostic as Moses himself. The creative mind, the mind that is like to the human mind, only so infinitely mightier and more original in design, is in nature, and, whether as first or second, is sufficiently above human nature as to be to it a creator, a designer, a maker. "It is ridiculous," he says, "to suppose that such phenomena as those of organic life are merely the result of chance." The very essence of chance is uncertainty. Chance is the principle of the inconstant. "But the phenomena in question present a high degree of constancy, and can be foretold with more or less of precision. It is quite plain that, besides the necessary forces of matter, there is something else at work which guides and co-ordinates these, so as to make them converge to a predetermined end. If a man cannot see this, it is absurd to argue with him; as well try to convince a man born blind, who denies the existence of colour. You see a house or a ship, and without hesitation you infer that such house or ship was made for the purposes to which ships and houses are subservient. Why? Because they are manifestly adapted to those purposes. Why, then, when you see a plant or an animal with equally manifest adaptations do you hesitate to draw a similar inference? True, in one case you can see the agent at work, while in the other the agency is invisible. But why should this make any difference? The agency in the latter case is invisible because it is an internal force, a something acting inside the material. It is as though the invisible shipwright were away and his art were inherent in the timber itself. Moreover, if the agency itself is out of sight, the model from which it works is visible enough, is as visible and palpable as the model of the ship or the plan of the house, and, like them, examinable before either is constructed." Could Aristotle have seen at work one of our modern power looms and have observed how, so long as it was fed, it produced results that unconsciously converge to a predetermined end, he would have drawn from this source another and striking illustration. He would have said here is another instance of an invisible agency working as if the art were truly inherent in the thing itself. It is matter in motion and in direction, producing something by fixed rule, but dependent, nevertheless, on something else which is independent and antecedent.

The great argument left behind, we follow the master to lower but still exalted fields of thought, speculation, and description. We follow him from the metaphysical to the physical, from the formative principle to the things that are formed, and from these in their details rather than in their mass. It is in this part of the original work that the critic comes in with power, and is able to try the quality of Aristotle by the hard test of examination of fact, by the side of statement. Thus adjudicated upon, Aristotle is found to be wanting, or, to use a word that has been applied to him, a "failure." He is said to fail in description of objects actually before his eyes. He is said to fail in generalisation, to have been hasty in generalisation, and to have reasoned on too small a basis of facts. Lastly he is said to fail in method, a failure which was certain to follow if the facts and the generalisations from them are both at fault.

Against all these charges Dr. Ogle defends Aristotle with true and honest skill. He does not defend error nor gloss over defect. He takes the natural common-sense view that Aristotle, in the conditions under which he lived and worked, performed the most signal services: that when he failed to see as we see, he failed because he had no means of seeing; that when he failed to generalise correctly, he failed because the stage to which biology had attained in his time made failure a matter of necessity; that he failed in method because in fact his was the first method, and because verification, which is essential to perfection of method, "does not find its proper sphere in the early condition of a nascent science, when the generalisations are merely provisional, and the false yet necessary precursors of more accurate ones."

The defence really leaves nothing to be desired; it is that which the master would, we believe, have made of himself by himself, could he speak for himself.

If there be one observation which in difference and in deference, we would offer in respect to this defence, it is on the comparison which is drawn between the Timæus of Plato and the work of his contumacious pupil. We admit that it "is the gap which separates the man, Aristotle, from his predecessors, not that which lies between him and his successors which gives the true measure of his position." We admit that when any one compares Aristotle's physiology with that of the Timæus, there is a wide distinction, but are we, really, in the transit "conscious of passing into an entirely new order of things?" We cannot declare this possible with such confident affirmation. It may be fairly said that a great deal in the Timæus is of airy and fanciful construction, but we do not think it fair to affirm that the construction is one "in which imagination alone supplies the foundation, and in which facts, if introduced at all, are introduced merely as ornamental additions in no wise essential to the fabric." This is a harsh judgment, and the more so because we are bound to take Plato as the prompter of Aristotle, and the teachings like those in the Timæus, with all the imaginings and poetry, as the promptings of the "Parts of Animals." To our minds it would be only just to say that the "Parts" was written on the Platonic design, and that if the teachings of Plato had not been placed before Aristotle his more correct and matter-of-fact work had never been born.

The "Introduction" of Dr. Ogle is followed by a chapter entitled "The Main Groups of Animals," in which the chief groups recognised by Aristotle are arranged as follows:—

I. Sanguineous Animals (Vertebrata). A. Vivipara (Mammalia). 1. Man; 2. Quadrupeds; 3. Cetacea. B.

Ovipara. *α*. With perfect ovum. 4. Birds; 5. Quadrupeds and Apoda (Reptiles and Amphibia). *β*. With imperfect ovum. 6. Fishes.

II. Bloodless Animals (Invertebrata). *α*. With imperfect ovum. 7. Malacia (Cephalopods). 8. Malacostraca (Crustacea). *β*. With scolex. 9. Insecta (remaining Arthropoda and some Vermes). *γ*. With generative slime; buds; or spontaneous generation. 10. Ostracoderma or Testacea (Mollusca excepting Cephalopods). *δ*. With spontaneous generation only. 11. (Zoophytes).

After this the text of Aristotle follows in four books, preceded by a Synopsis, and succeeded by the Notes, to which we have already directed attention. How excellently the notes are used to illustrate the text may be shown by one or two quotations. In Book III. Chap. V. Aristotle describes "that in animals of great size the heart has three cavities; in smaller animals two; and in all at least one."

"The reason for this, as already stated, is that there must be some place in the heart to serve as a receptacle for first blood. But inasmuch as the main blood vessels are two in number, namely, the so-called great vessel and the aorta, each of which is the origin of other vessels; inasmuch moreover as these two vessels present difficulties, it is of advantage that they also shall themselves have distinct origins. This advantage will be obtained if each side have its own blood and the blood of one side be kept separate from that of the other."

So much for the text. The notes in the most useful manner explain away one attributed error by Aristotle, while they remove one apparent error. They show that the statement universally made by writers on physiology that up to the time of Galen all philosophers supposed that the arteries contained nothing but air is incorrect, inasmuch as the text shows that Aristotle knew perfectly well that the arteries contain blood. They show again that Aristotle's apparently erroneous view about the cavities of the heart does not prove him ignorant. The three cavities he refers to are the right ventricle, the left ventricle, and the left auricle. He omitted the right auricle simply because he looked on it as a venous sinus, a part, not of the heart, but of the great vein, *i.e.* superior and inferior venæ cavæ. That he so regarded it is plain from his always speaking of the superior and inferior venæ cavæ as forming a single vessel, not two distinct vessels, and that the heart appears very much like a part of the great vein, being interposed between its upper and lower divisions.

Turning to another note bearing on a different, and, as we should now say, a chemical subject, we are offered an insight into the views of the philosopher, on the composition of natural substances. In the first chapter of the second book, the philosopher, in speaking of composition, says that there are three degrees of composition; and that the first of these, as all will allow, is out of what some call the elements, such as air, earth, water, fire. Perhaps, however, he adds, it would be more accurate to say composition out of the elementary forces; nor indeed out of all these, but of a limited number of them. With this observation as a text, Dr. Ogle explains that Aristotle in his other works is seen not only to look upon compounds as combinations of elements, but indeed to have a clear conception of the distinction between chemical combination and mere mixture: "for of the former he says that the combining substances disappear with their properties, and a new substance with new properties arises from their unification. In the latter, the mixed substances remain with all their properties, and it is merely the imperfection of our vision which prevents us from seeing the particles of each lying side by side, and separate. Had we the eyes of Lynceus, we should do so, however intimate the mixture might be." This knowledge is remarkable, though it may not be complete, or may not be completely expressed. It suggests an anxious desire to know more of the sources of knowledge from whence this master drew his chemical learning.

One more illustration from these useful notes belongs to the domain of natural history, and is connected in a way, singularly interesting, with history in a more general sense. Speaking in Book III. Chapter II. of the right and left organs of the bodies of animals, Aristotle says that the horns of animals are, in the great majority of cases, two in number. There are, however, exceptions, he thinks, to this rule in respect to the horns, for there are some that have but a single horn—the Dryx and the so-called Indian Ass. In such animals the horn is set in the centre of the head; for, as the middle belongs equally to both extremes, this arrangement is the one that comes nearest to each side having its own horn. Dr. Ogle, in his note on this passage, points out that the account of the Indian Ass, with a solid hoof and a single horn, was taken by Aristotle from Ctesias, and that it has been plausibly conjectured that the Indian Rhinoceros (*R. unicornis*) is the animal meant; for though, he says, this animal has three toes, they are so indistinctly separated that the real character of the foot might easily escape a casual observer. At the same time he observes that on the obelisk of Nimroud, made long before the time of Ctesias, there is represented a rhinoceros with feet distinctly divided into toes. An argument on the side of this supposed identification is, he adds, furnished by the fact that the horn of the Indian Ass was supposed to have certain magical powers, so that a cup made from it gave the drinker immunity from poison, as is related by Philostratus in his life of Apollonius; whilst similar virtues are assigned, in the East, to rhinoceros horn, even in the present day. If the one-horned ass of India be the *Rhinoceros Unicornis*, may not the asses with horns named by Herodotus as among the animals of Lybia, be the two-horned Rhinocerotes of Africa?

We have selected three illustrations of text and notes, one from anatomy proper, another from chemistry, a third from natural history, for the purpose of giving the reader a taste of the useful and most interesting study that lies before him when he takes up this book. We have rarely seen a volume which so intimately connects the science of the remote past with the science of the present, and which bridges over the distance as this book does. If there be a fault in it, it is that of condensation. In trying to compress and compress, and again compress, Dr. Ogle gets into the mode of using the first letter of the name of his author or book in his references; he also, for the same reason, in his note references, omits the page of the volume, and, as he does not supply a complete key to his method, he is sometimes, like "Bradshaw," rather vexatious, especially when his follower is anxious to discover quickly how to travel with facility from one point to another. On this detail, however, it were ungrateful to dwell with too much emphasis, and the more so as our own slowness of perception may have added greatly to the difficulty. It is far more pleasant in concluding, to propose to him a hearty vote of thanks, and to express the earnest hope that he will soon place before us some other classical work once buried in Scepsis or elsewhere, in similar English dress and form.

BENJAMIN WARD RICHARDSON

FLAMMARION'S "ASTRONOMY"

Les Étoiles et les Curiosités du Ciel. Par Camille Flammarion. (Paris: C. Marpon et E. Flammarion, Éditeurs, 1881.)

WHATEVER may have been the cause of that development of astronomical taste in England which would so greatly astonish our resuscitated forefathers, and is a puzzle to some plain-thinking people even at this day, the fact admits of no doubt; and a very cheering fact it is to those who value the intellectual and æsthetic progress of their fellow-countrymen. But it is perhaps not so generally known that a movement of the same nature has been in progress among our neighbours across the Channel. It originated later in point of time; for France had entered into no such competition when the Herschels Lassell, Dawes, Smyth, and other non-professional observers were attracting the notice of all Europe by their discoveries; and we recollect, less than twenty years ago, having heard from M. Léon Foucault a candid admission of the inferiority of his own country in amateur observation. But the Gallic mind is more rapid in its movements than our own; and though later in the field we are not sure that they are not shooting ahead of us in these matters in a way that we in general are perhaps hardly prepared to expect. At least, the fact mentioned in the volume before us, that during two years previous to last October, 300 telescopes had been sold to French purchasers, may be accepted as rather a startling proof: and not less so is the extraordinary circulation of the works of M. Flammarion, whom we may justly call the leader of the movement. As many as 50,000 copies in two years have been printed of his "Astronomie Populaire," of which "Les Étoiles" is considered the supplement; his "Merveilles Célestes" have reached 38,000; and his "Pluralité des Mondes" has come out in a 30th edition; to say nothing of other works of remarkable acceptation. Nor is it probable that the success of this publication will fall below that of its predecessors, treating as it does of a most interesting subject in an especially agreeable and familiar way. It is certainly not a volume which an English publisher would like to risk—an octavo of the largest size, of nearly 800 pages, and thick and heavy in proportion; anything in short but a handbook; but this, which would discourage an English buyer, is evidently no objection in the eyes of a Parisian firm. And it must be owned that in many respects it may well command a wide circulation. The idea is that of exhausting all the wonders of the sidereal heavens that the naked eye can reach, and describing their telescopic aspect; and it is excellently carried out for popular purposes: and we may add in certain respects for scientific ones also. The great value of the work consists in the especial pains taken with the probable changes of brightness in a multitude of naked-eye stars, not included in the ordinary enumeration of variables; but it is interesting in many other respects; and the close is enriched with a number of catalogues of telescopes, double and coloured and variable stars, their spectra, proper motions, parallaxes, and other data; together with many descriptions of planets, comets, &c. In short, it is a mine of information for those who do not care to dig deep; and those who would desire more authenticated and *weighted* details (observers will understand the word) may yet meet with much of interesting and valuable suggestion. The book has, however, some drawbacks which ought to be noticed.

Among many useful and some needless illustrations, there are a few (as that of the nebula in Andromeda, where the canals are invisible) of a very inferior stamp; and it is not free from carelessness in assertion, and even misleading statements; for instance, where Hevel is represented (p. 403) as never having in his life used the telescope for purposes of observation. The author should have said, as applied to divided instruments; or we might think he had forgotten the "Selenographia." Nor can we suppose that he made much inquiry as to the classical meaning of "in diem" (p. 525) when he rendered it "pendant le jour." The mythological part is more amusing than valuable: more agreeable perhaps to French than English taste; the theological—if it may be so called—is not only out of place, but worthless.

However, on the whole, the work displays a vast amount of industry and a wonderful range of knowledge; and the enthusiasm of the author for his subject is truly refreshing. Even when a process of unacknowledged appropriation has been indulged in, the borrowed plumage has been so ingeniously adapted and so gracefully worn as almost to claim unmerited forgiveness; but whencesoever his materials may be drawn he manipulates them with accomplished dexterity. His facile and lively style carries us most pleasantly along, and if his passionate eloquence is occasionally rather turgid for our more moderate temperament, it is sometimes exceedingly powerful and impressive. A more thoroughgoing manual might be produced for close practical study; but—allowing for the defects that we have mentioned—nothing that we know of as yet equals it for familiar use and attractive illustration.

OUR BOOK SHELF

Populäre Astronomie von Sim. Newcomb, Astronom in Washington. Deutsche vermehrte Ausgabe, bearbeitet durch Rud. Engelman, Dr. Phil. (Leipzig: Engelmann, 1881.)

THIS is much more than a simple translation of Newcomb's "Popular Astronomy," reviewed in these pages at the time of its publication. The editor thinks that as the original work was mainly written for American students, it would only be fair to German students and astronomers that the German edition should be adapted to a German standpoint. At the same time there is little trace of any special nationality in this edition, the aim of the editor having been rather to make it as complete and comprehensive as possible. Considerable additions have therefore been made both to the text and the illustrations, all of them we think improvements. In the second part, for example, much additional information has been added with reference to instruments and methods; additional details are given on the last transit of Venus, on spectroscopic methods, photography and photometry, &c. In the third part additional data are given with reference to the sun, its temperature, spots, rotation, spectrum, &c.; the chapter on Comets has been to a great extent re-written, and additional recent data given with respect to meteorites. Part 4, referring to stars and star-systems, astro-physical research, the development of our earth, &c., has also been considerably modified and added to. Several important modifications have also been made in the Appendix. The literature of the subject has been considerably extended and rearranged, while a series of biographical sketches of astronomers from the earliest date down to the present time has been added, a feature of great interest and utility. As frontispiece there is a fine portrait of Sir William Herschel. These are a few of the modifications which have been made in the German edition of Prof. Newcomb's work, some of which the author may consider it advisable to adopt in a new edition.

The Chemical Cause of Life Theoretically and Experimentally Examined. By Oscar Loew and Thomas Bokorny. *Brochure.* (Munich, 1881.)

THIS is a very important addition to our knowledge of the chemistry of plant life, or rather perhaps of the chemical reactions of "living" protoplasm. It is divided into two parts, a theoretical and experimental, following the idea first started by Pflüger concerning "physiological combustion in the living organism." One of the authors has already (*Pflüger's Archiv*, xii. 510) enunciated an hypothesis as to the formation of albumin by condensation of aldehydic groups with amido groups. As Nägeli has shown, various varieties of mould and Bacteria are able to build up the very complex albuminoid groups from relatively very simply constituted bodies like ammonic acetate, also from bodies like sugar, glycerine, &c., in the presence of ammonia or ammonia salts; it may be assumed that the same atomic group is split off and assimilated by the organism. The authors are of opinion that a group CHOH isomeric with formic aldehyde is the first or starting group in the formation of albuminoids. Such a group might possibly be formed, for example, by the oxidising action of moulds on acetic acid; or it might be split off from compounds where it already exists, the neighbouring group becoming fully oxidised. Considering that ammonic acetate and methylamine suffice under proper conditions for the building up of albuminoid groups, an otherwise constituted body than aldehyde can scarcely be considered. As the proportion of carbon to nitrogen in albumin is as 4 to 1, four such aldehyde groups may be imagined to combine with one molecule of ammonia to a group $\begin{array}{c} H_2N.CHCOH \\ | \\ CH_2COH \end{array}$, which, although not yet isolated would be an aldehyde of aspartic acid; and a further condensation of $\begin{array}{c} 3H_2NCH.COH \\ | \\ CH_2.COH \end{array}$, to $C_{12}H_{17}N_3O_4$, and this again under the reducing action of sulphur to $C_{72}H_{112}N_{18}SO_{22}$, two molecules of water being eliminated at each condensation. To prove the presence of an aldehyde group in living cells the reducing power of that body on solutions of salts of several easily reducible metals was examined in detail. The most reliable and rapid indication of the existence of aldehyde groups was found to be a very dilute silver solution. This reagent was decided upon after a very thorough examination of a number of other metallic salts with aldehyde and other carbon compounds. The experiments with cell substance or protoplasm of Algæ, &c., show that during the period of "living" the silver salt is always reduced to metal, but that when by any means heating or drying by the action of salts, &c.—which exert a dehydrating or antiseptic action by which the "life" of the plant is destroyed—the reducing action on silver salts is destroyed also. Some of the alkaloids afford a striking exception, the cell's substance yielding an equally distinct silver reaction before and after a week's treatment with one per cent. solution of strychnine, &c. The authors are of opinion that certain aldehyde groups exist in protoplasm, and that it is to the chemical energy of such groups that the "living properties" of the protoplasm are to be ascribed.

Between the Amazons and Andes; or, Ten Years of a Lady's Travels in the Pampas, Gran Chaco, Paraguay, and Matto Grosso. By Mrs. M. G. Mulhall. (London: Edward Stanford, 1881.)

THE regions traversed by Mrs. Mulhall have always had a great fascination for the traveller, and though a good deal has been done of late years towards obtaining an exact knowledge of these remote parts of the world, still there are vast tracts of country between the Andes and the Atlantic, which offer virgin fields for geographical research.

From Buenos Ayres to Cordoba, to Mendoza, and beyond the latter as far as the Inca's Bridge, with an excursion by sea to Rio Grande, and back by land by way of Villa de Melo, not to count sundry short excursions, constitutes a tour extending over several thousands of miles, that required all the courage and determination of an Englishwoman to accomplish, as Mrs. Mulhall has done, successfully; and this record of her visit to the ruined shrines of the Jesuit missions, to the hunting-grounds of several native tribes, to the little-trodden forests of the Amazons, and to the slopes of the Andes, will be read with interest and profit.

Mrs. Mulhall's account of the plague at Buenos Ayres in 1870 is most graphic: the destruction was fearful, the city losing 26,000 souls. The natural history notes are not numerous; now and then, however, some facts of interest are mentioned. On the line of the San Louis Railway the ostriches are so numerous as to cause much trouble; for whenever a workman left any bolt or screw out of his hand, were it only for a moment, they disappeared, being swallowed up by these birds, and one of the engineers declared that they even went so far as to pick the bolts out of the iron bridges if they were left by chance unriveted!

At Corrientes, the house of a friend of Bonpland, the botanist and companion of Humboldt, was visited, and Mrs. Mulhall gives us an extract from a manuscript in Bonpland's handwriting which begins: "I was born at Rochelle on August 29, 1773. My real name was Amadé Goujaud. My father—a physician—intended me for the same profession. It was on account of my great love for plants that he gave me the sobriquet of Bon-plant, which I afterwards adopted instead of my family name."

At Lomas a farmer's wife gave the authoress a sample of white silk made by a large harmless gregarious spider. The silk appeared suitable for weaving, and a pair of stockings made from it are said to have been sent as a present to the King of Spain.

As an appendix to the second volume there is a history of the rise and fall of the Jesuit Missions in South America. The rise of these Missions marked a period of great prosperity. During the seventeenth and eighteenth centuries they were a theme of admiration among the writers and statesmen of Europe. To-day the traveller sees but the ruins of splendid churches that were built during that time, and the remains of some native sculpture and wood carving.

Geometrical Exercises for Beginners. By Samuel Constable. (London: Macmillan, 1882.)

THE title of this book seems to us hardly to hit the object for which it is really adapted. Exercises for beginners we should expect to be confined to the very simplest deductions, and these should be most carefully graduated, whereas the exercises before us do not seem to be arranged in any very clearly-defined order. For instance, at one time we are in the first book, in the next question in the sixth book, and then back to the third, and so on. The references are apparently to Euclid, but not to editions in use in this country, as our author inserts on pp. 118, 120, 121, propositions which figure as Euc. vi. B, C, D, in Simson's text; on p. 126 a solution is given from Lardiner's (*sic*) Euclid.

The solution on p. 112 strikes us as not being the neatest that can be given of the exercise, and the figures on pp. 109, 110 are a little wrong. Having had our grumble, we must now say that we think Mr. Constable has produced a very fair book, with neat solutions and good figures, but we do not consider such a book called for. Every mathematical master has such a collection either in manuscript or ready for *vivâ voce* teaching, and has the more advanced works of McDowell and Casey on his shelves. We can, however, suggest that the little book may be of use in preparation for University Local, and other examinations, though we do not see its suitability for *beginners*.

Algebra. Part II. By E. J. Gross, M.A. Second Edition. (London: Rivington, 1882.)

WE are glad to see that this work has been so appreciated, that a second edition has been called for. The main defect of the first edition, in our opinion, was the plentiful crop of errata. This volume, we notice, has not been at all altered in the text, but very many of the errors have been corrected: we wish we could say that all errors had been removed, but this is not so. There are one or two curious slips: thus, for instance, in the Answers, p. 313, a correction is retained from the earlier edition, whilst the indicated alteration has been made in the text. Barring the errata, we again confidently commend Mr. Gross's book.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Pronunciation of Deaf Mutes who have been Taught to Speak

THE conclusions arrived at by M. Hément (*Comptes Rendus*, xciii. pp. 754, 861, 1095) and Mr. Axon (NATURE, vol. xxv. pp. 101, 409; *Comptes Rendus*, xciii. p. 904) concerning the influence of heredity upon the speech of the deaf cannot be accepted unless it can be shown that the peculiarities of utterance to which they have directed attention *could not have arisen in the ordinary way by imitation of the speech of others.*

Before we can decide whether any observed peculiarity in the utterance of a deaf person is due to inheritance or to imitation, we must know (1) at what age he became deaf; (2) whether the deafness was total or partial; and (3) whether, since the acquisition of speech by the sense of sight, the deaf subject has associated with persons who speak with the accent of his native district.

The remarks of M. Hément are valuable as the result of personal observations, but he has failed to be explicit upon these important points.

The cases referred to by Mr. Axon are equally inconclusive for the following reasons:—

1. In the first case noted (NATURE, vol. xxv. p. 101)—which is also the one to which Mr. Axon directs special attention in his recent letter to NATURE, vol. xxv. p. 409—we have a case of undoubted imitation through the sense of hearing.

Indeed it is stated in the *Phil. Trans.* No. 312, that some weeks after recovery from an illness, this young man (Daniel Fraser) "began to *hear* and in process of time to understand speech. This naturally disposed him to *imitate* what he heard and to attempt to speak."

The account from which this is quoted, is evidently intended simply as a record of a case of recovery of hearing in a deaf mute, with subsequent acquisition of speech; and Mr. Axon himself admits that the writer mentions the inheritance of the Highland accent "in a purely incidental manner."

With due deference to Mr. Axon's opinion, it appears to me that this is not a case in point, and that it is not entitled to the same consideration as that of a person who, remaining deaf, acquired speech through the sense of sight, and has no opportunity of imitating by ear the pronunciation of others. It must also be remembered that this case is quoted from an old number of the *Phil. Trans.*, and cannot now be verified.

2. The circumstances quoted from the "Life and Journals of George Ticknor" (NATURE, vol. xxv. p. 101) are unreliable, because Ticknor *assumed* that all the pupils in the deaf and dumb schools he examined could never have heard a human sound,[1] whereas it is now known that a very large proportion of the deaf and dumb (probably more than 50 per cent.) could hear in infancy, and that of these a large proportion could also speak before becoming deaf.

3. In regard to the case of "E. R.," who had been taught articulation by Mr. Alley, of Manchester, Mr. Axon says, "that he became deaf and dumb *at a very early age*" (NATURE, vol. xxv. p. 191), but neglects to state at what age, which is very important—nor had Mr. Axon himself heard the articulation of this young man.

These are all the instances I know of, in which it is claimed that the pronunciation of any deaf person was due to inheritance, and I think I have shown that in all these cases the necessary data for such a conclusion have been wanting. I have already stated in a former communication (NATURE, vol. xxv. p. 124, *Comptes rendus*, xciii. p. 1036) that I have examined the pronunciation of at least 400 deaf children who have been taught to speak, without finding a single instance of peculiarity that could correctly be attributed to heredity. If any further argument is needed against inheritance of pronunciation, it is to be found in the universal fact that children who are born deaf are *always also dumb.*

That there is no incapacity of the vocal organs to account for this is evident, for these so-called "deaf-mutes" are now taught, through the medium of the sense of sight, to control the movements of their vocal organs so as to give utterance to intelligible words.

When we examine the languages and dialects of the world, I think we find that they have something in common, while each retain distinctive characteristics of its own. There seems to be a universal tendency to express the *emotions* in the same way. We speak, in fact, two languages at the same time:—One—the language of thought—arbitrary and conventional, acquired by imitation and not hereditary, consisting of articulations constituting words and sentences which can be recorded and preserved in written books; the other—the language of the emotions—natural and universal, consisting of looks and gestures, and of intonations of the voice. There seems good reason for the belief that this natural language of the emotions is instinctive, and therefore hereditary. From my own personal observations I feel sure that those who are interested in questions of heredity will find a rich field for inquiry in the study of the facial expressions and gestures of very young blind children; and in the natural sounds and the modulations of the voice of deaf infants.

Rome, March 6 ALEXANDER GRAHAM BELL

IN his letter on the above subject in NATURE (vol. xxv. p. 409) Mr. Axon appears not to appreciate the value of negative testimony in scientific investigation.

The citation of cases in support of M. Hément's statement that deaf mutes who have been taught to speak do so with the accent of their native districts, obviously implies the promulgation of a theory that dialectal accent is due to physiological peculiarities (? of the verbal organs), and that these are hereditary. This is shown by the objections raised to Prof. Graham Bell's statement that all such phenomena are due to "the unconscious recollection of former speech, and cannot be

[1] "Not one of the pupils *of course* can ever have heard a human sound," &c. "Life and Journals of George Ticknor." London, 1876. Vol. I. p. 196.

attributed to heredity." Now in order to be admissible, a theory must harmonise with all the phenomena. It is an admitted axiom in science that even one "negative" case is all but fatal to a theory. Dreams occasionally "come true," and persons who have been impressed by such coincidences base on them a belief in ghosts. But the great majority of dreams do *not* come true, and therefore science does not recognise the existence of ghosts. Careful investigation may bring out many explanations of a few cases of deaf "mutes" apparently speaking with the accent of their native districts, without attributing the phenomena to heredity. But if dialectal accent is hereditary, how are we to explain the 400 cases cited by Prof. Bell (to name one competent observer alone) in which no such accent was observable?

Mr. Axon quotes (apparently with approval) M. Hément's declaration of inability to conceive "how in losing the use of speech, deaf mutes should retain the unconscious memory of accent." I wish to suggest that such phenomena may be due to automatic activity of the cerebral tissue. In his last "Causerie," in the *Rappel*, M. Victor Meunier mentions the case of a young man, an inmate of a French asylum, who six years ago became deaf with the right ear through the effects of typhoid fever. He is occasionally conscious of sounds on the right, or deaf side, of which the left ear gives no indication whatever. He hears entire sentences, distinctly articulated, and as these are sometimes of an offensive character, they have involved him in many quarrels, as he has attributed them to perfectly innocent persons who have chanced to be near his right side at the time. Notwithstanding this hallucination, his judgment has remained sound, and having discovered that he sometimes hears (with his right ear) absent or stopped clocks strike loudly, he has learned to disregard any sounds but those which his left ear communicates to him. M. Luys, of the hospital of La Salpêtrière, gives many illustrations of such automatic activity.

Remembering that memory has a physiological basis, and believing in the psychical basis of language, I find it far less difficult to conceive that after the loss of speech deaf mutes should retain the "unconscious memory" of accent than that accent should be hereditary. Indeed the loss of speech might even be favourable to such retention; for the particular cells concerned might keep the original impression unimpaired by subsequent impressions, to be accurately given forth again when the requisite conditions came into operation.

This does not explain the case of Daniel Fraser, said to have been mute from his birth; but, on the other hand, "one swallow does not make a summer." F. J. FARADAY

Manchester, March 4

Vignettes from Nature

WITH all due deference to Dr. Carpenter, for whose supreme authority on all matters of biological fact I have, of course, the profoundest respect, I must plead that he evidently has not looked into my little book, "Vignettes from Nature," but has taken his statements at second hand from the necessarily condensed account given in Mr. Wallace's kind review. Had he consulted the book itself, he would have found most of my remarks intentionally so guarded as to escape his strictures.

First, as to the sharks. Dr. Carpenter says, "None of these, in the judgment of Mr. Grant Allen and Mr. Wallace, surpassed the forty-feet sharks of the present time"; and he goes on to speak of a *Carcharodon* tooth from the Crag, 4 inches long by 3 broad. Now, in "Vignettes," p. 76, I wrote, "The teeth of what seems to have been the biggest known fish, a prodigious shark, are dredged up in the modern ooze of the Pacific. . . . They have become extinct at a very late date." I took my facts from Dr. Günther's "Study of Fishes," p. 321, where we read as follows:—"*Carcharodon* teeth are of very common occurrence in various tertiary strata. . . . Some individuals attained to an immense size, as we may judge from teeth found in the Crag, which are 4 inches wide at the base, and 5 inches long. . . . The naturalists of the *Challenger* expedition have made the highly interesting discovery that teeth of similar size are of common occurrence in the ooze of the Pacific, between Polynesia and the west coast of America. . . . The gigantic species to which these teeth belonged must have become extinct within a comparatively recent period." In short, the very shark which Dr. Carpenter claims as tertiary, I had previously claimed as also nearly modern.

Dr. Carpenter further says, "Is it clear that *Tridacna* is the largest known Mollusk? I should have thought it exceeded by the gigantic *Ammonitidæ*, &c." But if he will turn to "Vignettes," p. 75, he will see that I wrote, "No fossil *bivalve* molluscs to my knowledge are as big as . . . tridacna." The word I have italicised makes all the difference. On p. 77 Dr. Carpenter will see that allusion is made to the big Cephalopods, though perhaps none of these were very much larger than the largest modern gigantic squids.

As to the other points, they are really matters of language, and I will not take up your space by answering them in detail. When I spoke of "our whales," I certainly did not mean to exclude extinct whales: I merely meant to contrast them with the great secondary Saurians. Nor did I say that horses, elephants, &c., had been steadily increasing in size from "the earliest epoch of their appearance to the present day"; I said, "to the recent period," which is quite another thing. As I was writing for popular readers, not for biological critics like Dr. Carpenter, I felt bound to use the vague but comprehensible language of ordinary life; and so I described the mammoth as "recent," quite justifiably, I think, for my existing purpose. No technical words were used in the volume, and it was impossible always to find popular ones quite free from objection. But if Dr. Carpenter will kindly read the short chapter in question, I venture to think he will be willing to withdraw his present strictures. The object was merely to combat the vulgar notion that all the animals of all geological ages were positively gigantic; and in doing so, almost every animal mentioned by Dr. Carpenter was expressly adduced as an example.

In answer to ΦΠ, I should like to add that I used the word "accidental" in a strictly Pickwickian sense.

GRANT ALLEN

Miss Cobbe and Vivisection

WILL you allow me as one not only ardently interested in the pursuit of vivisection as a means of extending our knowledge, but also as a sincere hater of unnecessary cruelty to animals, to state the following facts which I know to be true:—

Some little time ago Miss Frances Power Cobbe, who has so identified herself with the cause of anti-vivisection, called on a distinguished man of science to endeavour, by persuasive speech and *vivâ-voce* argument, to gain him over to her cause. Three points were observable in Miss Cobbe's outward presentment, viz.: she had an ostrich feather in her bonnet; a bird of paradise in, on, or near her muff; and she carried an ivory-handled umbrella; consequently the distinguished man of science replied as follows:—

"Madam, charity begins at home; when you have given up wearing *ostrich feathers*, which are plucked from the *living bird*, causing the most exquisite pain, and birds of paradise, which, in order to enhance their beauty and lustre, are *skinned alive*; when you have abjured the use of *ivory*, because you know that the tusks are *cut out* of the dying elephant's jaw, then, and then only, come and upbraid me with the cruelty of my operations. The difference between us is, Madam, that *I* inflict pain in the pursuit of knowledge, and for the ultimate benefit of my fellow-creatures; *you* cause cruelty to be inflicted merely for your personal adornment . . . " H. H. JOHNSTON

Zoological Gardens, Tuesday

The Electrical Resistance of Carbon under Pressure

FROM the abstract of the proceedings of the Physical Society, given in NATURE, vol. xxv. p. 426, I learn that Prof. S. Thompson has been making some experiments which tend to show that the observed diminution of the resistance of carbon under pressure in such instruments as the carbon relay, rheostat, and microphone-transmitter is really due to the contact between the electrodes and the carbon. No doubt the greater portion of the observed diminution of resistance is due to this cause, and I have already pointed out in my paper on "the Influence of Stress and Strain on the Action of Physical Forces," Part ii., Electrical Conductivity, an abstract of which (NATURE, vol. xxv. p. 401) was read before the Royal Society on January 26, that the effect of a given amount of longitudinal traction or compression per unit area on the electrical resistance of some carbon rods was not greater than is the case with the metals tin and lead, for whereas a stress of 1 gramme per sq. cm. produced a variation of conductivity of from 7684×10^{-12} to 11420×10^{-12} per unit in the case of five carbon rods, the corresponding numbers were, with tin and lead, 10540×10^{-12} and 17310×10^{-12} respectively. The carbon rods were of the sort used for the purposes of electric lighting, and their elasticity varied in almost the same proportion as their susceptibility to change of resistance from stress, so that, the alteration of resistance divided by the strain produced, ranged in the five specimens between the limits 2·144 and 2·835. The corresponding numbers in the case of most pure metals (aluminium is an exception) are *greater* than these, and in the case of nickel, with which metal curiously enough the effect of moderate longitudinal traction is to *decrease* the resistance, the alteration of conductivity is *much* greater.

It will be observed from the numbers given above that the diminution of resistance which can be produced in carbon by pressure is very slight, so much so indeed that if we could compress a carbon rod to *half* its original length, the resistance would not be diminished to one-third of the original resistance, and that therefore the amount of compression which can be really produced without danger of breakage causes such a slight decrease of resistance as requires special precautions and a good galvanometer if this decrease is to be measured with any accuracy.

King's College, Strand, March 7 HERBERT TOMLINSON

Palæolithic Floors

IN reference to this subject, as adverted to by Mr. W. J. Knowles, NATURE, vol. xxv. p. 409,—several Palæolithic working-places, floors, or old land surfaces have been described. With some of these surfaces, I am slightly acquainted, and with one of them I am *well* acquainted, as it was discovered by myself in London, in 1877–8. This surface is in the Valley of the Hackney Brook, an affluent of the Lea, which in its turn is a northern tributary of the Thames. The course of the Hackney Brook is illustrated in the No. of NATURE (p. 417) which contains Mr. Knowles' letter; when excavations are made in this valley, Palæolithic implements and flakes are disinterred, which in some instances belong to the Thames and are very ancient, in others to the Lea and probably somewhat less ancient, whilst a third set of implements belong to the Hackney Brook, and undoubtedly date from a very recent period of the Palæolithic age. In the surface humus of the Lea near the Hackney Brook, Neolithic celts, polished and unpolished are also found with flakes of the same age.

When I first found Palæolithic implements in the gravel, sands and loam of north-east London, I was greatly puzzled by some of the examples being considerably abraded, whilst others were as sharp as if just made. The sharp examples belong to one stratum and the abraded specimens to a totally different one. The explanation of the abraded and unabraded examples rests in the fact that near the Hackney Brook most of the gravel is about ten or twelve feet below the surface, but this Thames gravel and its contained abraded implements has nothing whatever to do with the Hackney Brook, the old banks of which are about four or five feet below the present surface, and on these banks (which I have examined in the stream's course for three quarters of a mile, north and south at Stoke Newington, and Shacklewell) there lived at one time a considerable colony of Palæolithic men. The floor upon which this colony of men lived and made their implements has remained undisturbed till modern times and the tools, together with thousands of flakes, all as sharp as knives, still rest on the old bank of the brook just as they were left in Palæolithic times. In some places the tools are covered with sand, but usually with four or five feet of brick-earth; the sand when it occurs is full of the shells of fresh-water molluscs.

The floor is exposed in digging for the foundations of houses, it is sometimes visible as a dark line only at the base of the loam; at other times by the presence of a few inches of gravel; occasionally the traces of the floor are obliterated. All the implements from this floor are as sharp as on the day they were made, a few are dull in colour, the majority are lustrous, a few are whitish from their long contact with clay, but though the surface of the implements is whitened by decomposition, yet the tools remain perfectly sharp. As a rule the implements of the Hackney Brook are small in size, beautifully made, and extremely neat, some rivalling in exquisite workmanship the best Neolithic work: scrapers are fairly common, but not of the horse-shoe form. Were the makers of these tools the same with the men of some of the caves? the evidence seems to point in that direction. "Cave-men" could not always have been in caves, surely some of these "Cave-men" lived in communities in the open air, and it seems clear that if we are to find intermediate links between Palæolithic and Neolithic times we must not confine ourselves to caves but search for traces in positions like the comparatively modern Valley of the Hackney Brook.

It appears to me that these minor tributaries of great rivers have never been properly searched. Geologically considered, the Thames with its gravel and implements must be extremely ancient, whilst the shallow unimportant Hackney Brook must be comparatively modern. In these minor affluents then we have traces of the more recent cohorts of Palæolithic men, and the tools that are found, seem, by their style of workmanship, to prove their comparatively recent date.—Recent as that date may be however, I consider it to be far older than the times when the lower terraces of the Thames were laid down, for in these lower gravels, implements and flakes (with the exception of some stray example now and then, that has been washed down from a higher position) are absent.

Any person is at liberty to look over the things I have got from this place, but at present I do not wish for the number of the tools to be further reduced by gifts or exchanges. Many objects I have already given away, but, for a time, at any rate, I wish to *keep the things together*, as they teach a better lesson *in company* than when distributed in different collections. As for the simple flakes, whether sharp and belonging to the till now undisturbed Palæolithic floor of the Hackney Brook, or abraded and belonging to the deeper excavations exposing the old terrace of the Thames, any one is welcome to any number of examples of these from me, and I am willing to send them as gifts to anyone, provided I am not put to expense in transit.

At the present time the Palæolithic floor is to be seen in section in several places, and I will conclude by mentioning one. On the north side of Stoke Newington Common, (nearest point, Stoke Newington Railway Station, from Liverpool Street) there are four new roads; the easternmost road is named Fountayne Road, and is marked on Stanford's Library Map of London. At the extreme south end of Fountayne Road, *i.e.* the Stoke Newington Common end, on the east side, shallow foundations of about four feet have been dug for a few new villas; now, if the two or three northernmost of these shallow excavations are looked into at a depth of about three feet, a thin stratum of gravel, a few inches only in thickness, will be seen sloping southwards into the (here filled in) Hackney Brook. This is the floor upon which the Palæolithic men once walked, lived, and made their tools. In the excavation for the two northernmost villas I recently saw the loam carefully removed, and on this spot two pointed Palæolithic implements (one amongst the best of my collection) were found, the first black and lustrous, the other buff, mottled with white from long contact with the loam, and lustrous, both as sharp as knives; they were picked up with numerous flakes on the very spot where they were originally laid down by their Palæolithic owner or owners.

A word of warning to visitors. After I published my localities in 1868, certain persons went to the places mentioned, and offered large sums of money to the men for implements and flakes; in this case, the unfortunate result was, that the men and boys of this spot soon found that they could strike off flakes and even make implements sufficiently near to deceive "avid but unwary collectors." Therefore, unless any visitor instantly knows at sight (which is quite easy) a genuine implement or flake from one made on the spot, let him buy nothing of the boys or men without first consulting the writer of this note.

WORTHINGTON GEO. SMITH

125, Grosvenor Road, Highbury, N.

The Advance of Norwegian Glaciers

IN NATURE, vol. xxv. p. 449, you quote an account from *Naturen* of the changes of movement observed in Norwegian glaciers. In this it is stated that the great Folgefond glacier, near the Sörfjörd, a branch of the Hardanger, has had alternation of advance and retreat, but that it advanced 40 metres between 1860 and 1878. This, no doubt, is an account of the very remarkable advance of the Buerbrœ (brœ is Norsk for glacier) near Odde, on the Sörfjörd. I visited the place in 1874, and the recent ploughing up of a considerable bit of the valley by the vast irresistible ice-plough was very striking, while the glacier itself was very beautiful. My object, however, is to repeat a strange piece of folk-lore, which tends to show that in this particular spot, the advance of the glacier must have been long-continued. The legend was told me by Asbjörn Olsen, a very intelligent guide at Odde, who speaks good English. The tale was that long ago the Buer valley extended far into the mountains, and was full of farms and cultivation. It had also a village, a church, and a pastor. One winter night when a fearful storm was threatened, three Finns (*i.e.* Lapps) entered the valley and begged shelter in vain of the inhabitants. At last they asked the priest, and he too refused. Then the wrath of the heathen wizards was raised, and they solemnly cursed the valley and doomed it to destruction by the crawling power of the ice, until the glacier reached the lake below. The Lapps were seen no more, but on their disappearing the snow began to fall. The winter was awful. The glacier approached by awful steps, and by degrees engulfed the cursed valley and farms. Nor is the curse yet exhausted, for the glacier creeps down the valley each year, and has yet a mile to go before it reaches its destination in the lake above Odde. I am no judge of folk-lore, but this weird tale seemed to me a genuine piece of it, and not invented for the occasion, as Olsen gave it half jokingly as the tradition of the district. The farmer who owns the remnant of the doomed valley, wanted then to sell it, as he saw his acres swallowed up each year, but no one will buy. If this tale be genuine, it points to a prolonged advance of the Folgefond, which has led to the tale of the Lapps' curse. Those interested in ice-action will see a fine example of the "Tyssenstrengene," or polished stone fells of Norway, between Odde and the splendid Skjægadals (or Ringedal's) Fos. The rocks are so polished by the ancient ice that a path is made over them by putting rough fir trees down to give a foothold. The ice-polishing on the Grimsel Pass in Switzerland, is a mere nothing to these "Tyssenstrengene."

J. INNES ROGERS

Intelligence in Birds

OUR English jackdaws are not behind Miss Bird's Japanese crows in at any rate one of the instances of intelligence told by her. Many years ago it was a frequent amusement of ours to watch the encounters between a tame jackdaw and the stable cat. The cat's dinner used to be put down outside the stable-door, and, warned by experience, she hastened to dispose of as much as possible before the arrival of the jackdaw. He seldom went directly to the meat in the plate, but attacked the enemy in the rear, settling himself with both feet on her outstretched tail to steady it, and then administering pickaxe blows on it with his beak. Of course it was impossible to stand this, and with a forcible exclamation the cat used to spring away, and Jack took possession of the plate, until our sense of justice obliged us to recall and defend the rightful owner.

E. HUBBARD

March 6

Auroral Display

I SEE by your number of NATURE, vol. xxv. p. 386, that an auroral display was witnessed in England on February 20, between 7 and 8 p.m. A very magnificent one was seen in the Hardanger-fjord on the same evening at the same hour, by a friend of mine, and the Captain of the ss. *Folgefonden* says he has never seen a finer. Could it have been the same aurora?

W. E. KOCH

Lysefjord near Stavanger, Norway, March 9

ON THE CHEMISTRY OF THE PLANTÉ AND FAURE ACCUMULATORS

PART II.—*The Charging of the Cell*

IN NATURE (vol. xxv. p. 221) we directed attention principally to the local action that takes place on the negative plate of a Planté or Faure battery. We pointed out the close analogy between zinc coated with spongy copper, and lead coated with spongy peroxide, in their action on water or dilute sulphuric acid; and we showed the importance of the lead sulphate produced in moderating this action. We now propose to treat of the chemical changes involved in the preparation of the cells.

The procedure of Planté in forming his battery is at first sight extremely simple. He takes two coils of lead, separated from one another, and immersed in dilute sulphuric acid; a current is sent through the liquid from one lead plate to the other, and the final result is, that the one becomes covered with a coating of lead peroxide, while hydrogen is given off against the other plate. On the view that the sulphuric acid merely serves to diminish the resistance, and so facilitate the electrolysis of water, the ready explanation would be given that the two elements of the water are simply separated at the two poles. But it seems more in accordance with the facts of electrolysis, to suppose that the sulphuric acid, H_2SO_4, is itself the electrolyte, and that the oxygen results from a secondary chemical reaction. As a matter of fact, if water be employed, no peroxide is formed, but only the hydrated protoxide, even though a current from twenty-four Grove's cells be made use of. The addition of a single drop of sulphuric acid to the water is enough to cause the immediate production of the puce-coloured oxide.

If we take two plates of lead in dilute sulphuric acid, and pass the current from only one Grove's cell, a film of white sulphate, instead of peroxide, makes its appearance on the positive pole, and the action practically ceases very soon. If, however, the current be increased in strength, the sulphate disappears, and peroxide is found in its place. In Planté's procedure, spongy lead, and lead peroxide are indeed found on the respective plates. But, in consequence of the local action which takes place during the periods of repose, lead sulphate will be produced from the peroxide, and afterwards, in the course of the "formation," this must be reduced to metallic lead by the hydrogen.

It may seem at first sight improbable that an almost insoluble salt of the character of lead-sulphate should be decomposed under these circumstances. To test this fact by direct experiment, we covered two platinum plates with lead-sulphate, immersed them in dilute sulphuric acid, and sent a current through. We found not only that the sulphate was reduced by electrolytic hydrogen, but that it was peroxidised by electrolytic oxygen. The white sulphate was, in fact, decomposed to a large extent at each plate, the positive being covered with deep chocolate-coloured peroxide, the negative with grey spongy lead.

The reaction which takes place in charging a Planté battery may be viewed in two ways. The simplest may be thus expressed in the notation which we have employed in some previous papers. For convenience, the reaction is divided into two stages:—

$$Pb_x \left| \begin{matrix} SO_4H_2 \\ SO_4H_2 \end{matrix} \right| Pb_y = Pb_{x-1} \mid PbO_2 \left| \begin{matrix} SO_3 \\ SO_3 \end{matrix} \right| \begin{matrix} H_2 \\ H_2 \end{matrix} \right| Pb_y.$$

and $$2SO_3 + 2H_2O = 2H_2SO_4.$$

But it may be that lead-sulphate is always formed in the first instance, and decomposed on the continuation of the current.

$$Pb_x \mid SO_4H_2 \mid Pb_y = Pb_{x-1} \mid SO_4Pb \mid H_2 \mid Pb_y.$$

then

$$Pb_{x-1} \mid SO_4Pb \mid SO_4H_2 \mid Pb_y = Pb_{x-1} \mid PbO_2 \;\; \begin{matrix} SO_3 \\ SO_3 \end{matrix} \mid H_2 \mid Pb_y.$$

and $$2SO_3 + 2H_2O = 2H_2SO_4.$$

It seems not improbable that both these reactions may take place according to the varying density, or other circumstances of the current. The coating of peroxide interposes a great difficulty in the way of the further oxidation of the metallic lead. Hence Planté needs the successive periods of repose, to admit by local action of the formation of lead-sulphate, and the oxidation of the increasing amounts of finely-divided lead thus brought into the field of action.

To obviate this waste of power and time, Faure covers both plates with red lead, and converts this into spongy peroxide and spongy lead respectively by the current. Now the first thing that happens, when the plates are immersed in the dilute sulphuric acid is a purely chemical action. The minium suffers decomposition according to the formula—

$$Pb_3O_4 + 2H_2SO_4 = PbO_2 + 2PbSO_4 + 2H_2O.$$

But as both the lead sulphate and lead peroxide are insoluble, this takes place mainly at the surface, and requires time to penetrate. Thus in an experiment performed with the object of testing this point, the following amounts of minium were found to be converted into lead sulphate in successive periods of time.

Time.	Minium changed into sulphate.
15 minutes ...	11·8 per cent.
30 ,, ...	13·7 ,,
60 ,, ...	14·6 ,,
120 ,, ...	18·1 ,,

It might happen, and we are told it has happened, that the amount of minium employed has been great enough to abstract the sulphuric acid from solution, leaving only water. In that case water, of course, would be the electrolyte, and there can be little doubt that the lead plate would suffer oxidation in the manner which was described by us some years ago (*Chem. Soc. Journ.*, 1876) in a paper on "Phenomena accompanying the Electrolysis of Water with Oxidisable Electrodes." This paper detailed the results obtained on passing a current from one Grove's cell between two plates of the same metal immersed in pure water. We stated in the case of lead: "The positive electrode showed signs of slight oxidation, and the negative electrode a few small bubbles, in fifteen minutes; a slight cloudiness was then beginning to form, which afterwards increased; some oxide was found adhering in an hour; and afterwards grey metallic lead, which at the end of twenty-two hours was found to have stretched across to the positive electrode, forming a metallic connection which was so much heated by the passage of the voltaic current that the liquid became warm." We are informed that such lead crystals have sometimes been found in Faure's cells.

Supposing, however, that there is enough and to spare of sulphuric acid, the mixture of lead peroxide and lead sulphate presents a double problem. Were we dealing with peroxide alone, it would be reduced on the one plate at the expense of two molecules of water or sulphuric acid, while at the opposite pole the oxygen would simply be liberated.

$$\begin{array}{l} Pb \mid PbO_2 \mid SO_4H_2 \mid SO_4H_2 \mid PbO_2 \mid Pb_y = Pb_x \mid \\ PbO_2 \mid O_2 \mid SO_4H_2 \mid SO_4H_2 \mid Pb_{y+1}. \end{array}$$

But as there is always lead sulphate present, this liberated oxygen is mainly used up in oxidating that substance, and it is evident from the following formula that it is theoretically sufficient to peroxidise the two molecules of sulphate—

$$2PbSO_4 + 2H_2O + O_2 = 2PbO_2 + 2H_2SO_4.$$

These two molecules of $PbSO_4$ are obtained from one molecule of Pb_3O_4 (red lead), and it appears that two atoms of oxygen are sufficient to transform this into peroxide. But the corresponding amount of hydrogen (four atoms) by no means suffices to reduce a similar amount of red lead on the other side, for in this case both the peroxide and the sulphate formed by the action of the acid have to be reduced. To accomplish this at least eight atoms of hydrogen will be necessary, and this will demand the electrolysis of an additional two molecules of water or sulphuric acid. It might therefore be expected, *a priori*, that the minium on the side to be oxidated ought to be twice the amount of that to be reduced.

In order to ascertain what is the real course of procedure, in charging a Faure battery, we took two plates of lead of equal size, and covered each with a known weight of minium, which was almost pure Pb_3O_4. We passed a current of known strength, about one Ampère, through the arrangement for many hours, noting the amount of hydrogen gas which was liberated at the one pole, and the amount of oxygen liberated at the other. From the data it was easy to calculate the amount of electrolytic hydrogen and oxygen utilised. We performed the experiment several times, varying the strength of the current and some other circumstances. The most complete result was as follows:—

Time.	Hydrogen.		Oxygen.	
	Lost.	Absorbed.	Lost.	Absorbed.
hours.	c.c.	c.c.	c.c.	c.c.
1	Nil	312	Nil	156
2	,,	318	18	141
3	,,	306	48	105
4	,,	300	66	84
5	,,	300	72	78
6	2	313	90	67
7	5	295	87	63
8	3	312	96	61
9	6	303	93	61
10	21	297	99	60
11	37	273	99	56
12	101	220	105	56
13	150	158	105	49
14	195	132	105	58
15	210	92	100	51
16	228	90	106	53
17	225	85	100	55
18	270	66	108	60
19	264	51	108	49
20	270	50	111	49
21	273	43	114	44
22	270	30	114	36
23	276	30	114	39
24	297	21	123	36
25	309	9	126	33
26	270	18	120	24
27	300	18	132	27
28	309	11	138	22
29	321	15	141	27
30	318	15	147	19
31	300	6	135	18
	5230	4489	3120	1737

The amounts of hydrogen and oxygen capable of being absorbed by the materials on the plates were 4574 and 1294 respectively.

We read the indications of this table in the following way:—At first, both the reduction and oxidation take place very perfectly, with little loss of either of the elements of water. The absorption of the hydrogen proceeds with little diminution, until by far the greater part of the lead peroxide and sulphate are reduced, but the last portions are very slowly attacked, probably because they are imbedded in a mass of reduced lead. On the side that is being oxidated it is otherwise: a considerable waste of oxygen soon shows itself, but nevertheless a continuous slow absorption of that element takes place long after the theoretical amount of it has been fixed. A very small amonnt of this excess is to be attributed, according to our experiments, to the oxidation of the metallic plate itself. But we attribute the greater portion to the local action which must be constantly going on between the peroxide and the lead plate with the formation of sulphate of lead, the sulphate in its turn of course being attacked by the electrolytic oxygen. Thus the excess of oxygen in the fifth column of the above table may be looked on as a measure of the local action which has taken place during the charging, and the figures in the lower portion as roughly indicating its progress from hour to hour. Local action will of course take place at first on the opposite plate, but it requires no more hydrogen to reduce two molecules of lead sulphate, than one molecule of lead peroxide, and the possibility of local action gradually diminishes as the reduction proceeds.

All our other experiments told the same story as far as the absorption of hydrogen is concerned, but there are differences on the other plate. In one or two instances, not half of the theoretical amount of oxygen was absorbed. On searching into the circumstances on which this depended, we were unable to arrive at any other conclusion, than that it was connected with the condition of the surface of the lead plate.

Experiments with a current of about two Ampères showed that a larger quantity of both hydrogen and oxygen was fixed in a given time, but there was a larger proportionate loss, especially in the case of oxygen. Experiments with a current of about half an Ampère, on the contrary, gave a somewhat less rapid action, but a smaller waste of force through the escape of free gas.

A complete study of the results of these experiments would be instructive, but the following comparisons may suffice to illustrate the points just mentioned. The theoretical amount of oxygen required for the red lead used is about 1200 cc., and the table shows the length of time in which 300, 600, and 1000 cc. were fixed by different strengths of current, together with the accompanying loss.

Strength of current.	Amount of oxygen stored.	Time.	Loss of oxygen.
Ampères	c.c.	hours.	c.c.
2	300	1·5	174
1	,,	2	18
½	,,	3·8	15
2	600	4·1	617
1	,,	5·5	249
½	,,	7·6	47
2	1000	13·9	3081
1	,,	12·2	900
½	,,	16·0	400

In some cases we mixed the red lead with a little water, and allowed it to dry. In other experiments we mixed it at once with dilute sulphuric acid, but without any particular practical advantage.

The forming of a good secondary battery is a matter evidently depending upon very nice adjustment of conditions. It is but a few of these that we have carefully studied; nevertheless we feel ourselves in a position to make one or two suggestions in regard to the economic aspects of the question. It is evident that the energy stored up in a cell is determined mainly by the amount of peroxide present. This appears to be obtained with the smallest amount of waste when the current is not too strong; in fact, in our experiments it was obtained when the density of the current was about 6½ Ampères, calculated on the original surface of the lead plates.

There would seem to be no commensurate advantage in continuing the current after the oxygen has ceased to be absorbed pretty freely, because the presence of some unoxidised sulphate of lead, although it increases the resistance, rather impedes than promotes local action.

On the other hand, however, it is necessary that the reduction of the minium on the opposing plate should be complete, for a mixture of lead peroxide and metallic lead would be peculiarly conducive to the production of lead sulphate, and thus increase the resistance; while if any peroxide should remain, it would diminish the electromotive force of the cell.

It would appear probable, therefore, that the most economical arrangement would be obtained by making the red lead to be hydrogenated much smaller in amount than that to be oxidated. On trying the experiment with only half the quantity, we obtained a most satisfactory result as far as the charging was concerned. How far such an arrangement may be really desirable we hope to consider more fully when we treat of the chemistry of the discharge.

J. H. GLADSTONE
ALFRED TRIBE

March 9

THE CHANNEL TUNNEL

THE two schemes for a tunnel beneath the Channel, on the comparative merits of which a Parliamentary Committee will probably take evidence in the course of the year, are based, like those which have preceded them, chiefly on geological considerations. The Weald of Kent and the Bas-Boulonnais, once in all probability geographically continuous, still constitute a single geological area. The chalk of Calais and Sangatte forms the prolongation of that long range which, striking through Dover, Rochester, and Guildford, to near Basingstoke, is known as the North Downs; while that which strikes the coast south of Boulogne, is continued in Beachy Head, and the long range of the South Downs. The North and South Downs curve gently round, so as to meet towards the west, and similarly the Bas-Boulonnais is inclosed by the meeting of the two ranges on the French coast towards the east.

In both these districts the beds of the chalk dip away from the inclosed area, generally at a gentle angle as at Dover, but sometimes steeply as in the Hog's Back. It is clear from this that the beds which rise to the surface in the Weald and in the Bas-Boulonnais are geologically older than the chalk, and must pass under it laterally. The escarpments of the chalk may thus be compared to the fragmentary walls of an oval dome, the top of which has decayed away. The longer axis of this dome extended approximately east and west.

The sequence of beds from the chalk downwards is as follows[1]:—

		English Coast. feet.	Bas-Boulonnais. feet.
Upper	Chalk with flints	350	
	Chalk with few flints	130	
Lower	Compact nodular without flints	90	130
	Chalk without flints	50	
	Grey Chalk	200	180
Upper Greensand		0–12	0–3
Gault		100	30–36
Lower Greensand		250	12½
Wealden Beds	Weald Clay 350, Hastings Beds 800	1150	100 ?
Purbeck Beds		400	
Portland Beds		80	Sub-Wealden Boring[2]
Kimmeridge Clay		1070	
Coralline Oolite		550	
Oxford Clay		60	

Of these formations the Chalk and Gault have been proved to run with remarkable persistency over a very large area, changing in thickness slowly and uniformly in ascertained directions. It thus was a matter of the utmost probability that they would be found occupying their proper position relative to the other formations, and of their usual dimensions, in the narrow strip occupied by the sea. All doubts on this point were set at rest by the experimental soundings conducted by Sir J. Hawkshaw, and subsequently in greater detail by the French engineers, MM. Lavalley, Larousse, Potier, and de Lapparent; 7,671 soundings were taken by these gentlemen, and 3,267 specimens of the bottom were brought up, nearly all of which could be identified with certainty as belonging to one or other of the formations named above. A geo-

[1] The thicknesses of the Chalk on the English coast are taken from the Geol. Survey Memoirs, vol. iv.; those of the Bas-Boulonnais from the French Report of 1877, the thickness of the Lower Chalk being estimated by the position of the lowest beds of flint.

[2] There is some uncertainty as to the thickness of these divisions.

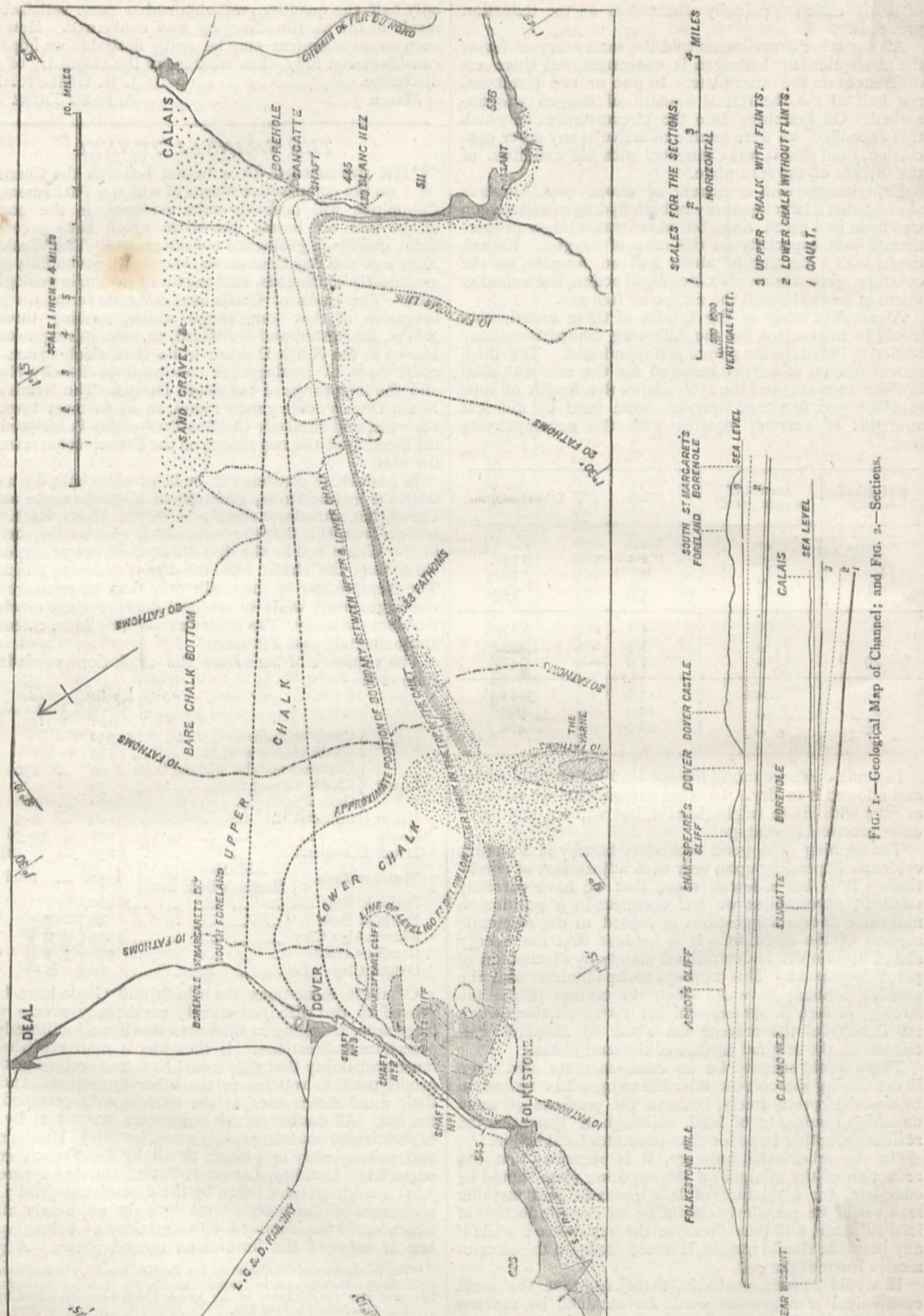

FIG. 1.—Geological Map of Channel; and FIG. 2.—Sections.

logical chart of the straits was thus made, showing the outcrops of the beds in the Channel from the Gault upwards. On this chart the submarine geology shown on the map (Fig. 1) accompanying this article is founded. The outcrop of the Gault is shown, and an approximate separation of the Lower Chalk from the Upper Chalk. It may be mentioned here that the lowest division of the chalk made by the French geologists, and known as the Craie de Rouen, does not exactly correspond with our Lower Chalk, which includes part of the overlying sub-division, the Craie Moyenne. The series of vertical sections (Fig. 3), which has been constructed to illustrate the remarkable persistence of the subdivisions of the Chalk, partly shows also the difference between the English and French classifications. The base of the Gault has been selected as an artificial datum line in plotting these sections.

The Lower Greensand on the other hand is probably represented only in its upper beds in the Boulonnais, while the Wealden beds are so changed and attenuated that the subdivisions made in England are unrecognisable in France. The Kimmeridge Clay reappears, but much reduced in thickness, as indeed is the case with all the lower secondary formations. For all these earlier beds rest upon an uneven rock-floor, carved out of a vast mass of contorted palæozoic rocks; and a ridge forming a prominent feature in this old surface existed in what is now the north part of the Bas-Boulonnais, and perhaps stood above water through all the earlier part of the Secondary Period, until it was finally submerged beneath the water of the Gault sea. The filling up of the inequalities in the old surface probably contributed to the more even distribution of the Gault and Chalk. The only point at which the Palæozoic Rocks now appear at the surface in the district is in the north-east corner of the Bas-Boulonnais, but they have been reached in boreholes in London, Calais, and Guines as shown in the sections.

It was proposed by Prof. Prestwich to carry the tunnel through these Palæozoic rocks on the grounds that they are of great dimensions, and protected by overlying impermeable strata. But their great depth has prevented much attention being paid to the scheme; at Calais they are at 1160 feet below the surface, in London 1064, and near Battle in Sussex they have not been reached at 1900 feet. It has also been suggested that a tunnel starting in the Weald Clay on the English might be carried through into the Kimmeridge Clay on the French side without encountering the intervening Portland beds, it being supposed that these watery strata might thin out and leave the two clays in contact. But at the present time the inquiry has narrowed itself to the Chalk, the lower part of which is not only most suitable for tunnelling, but has the advantage of occupying the narrowest part of the Channel.

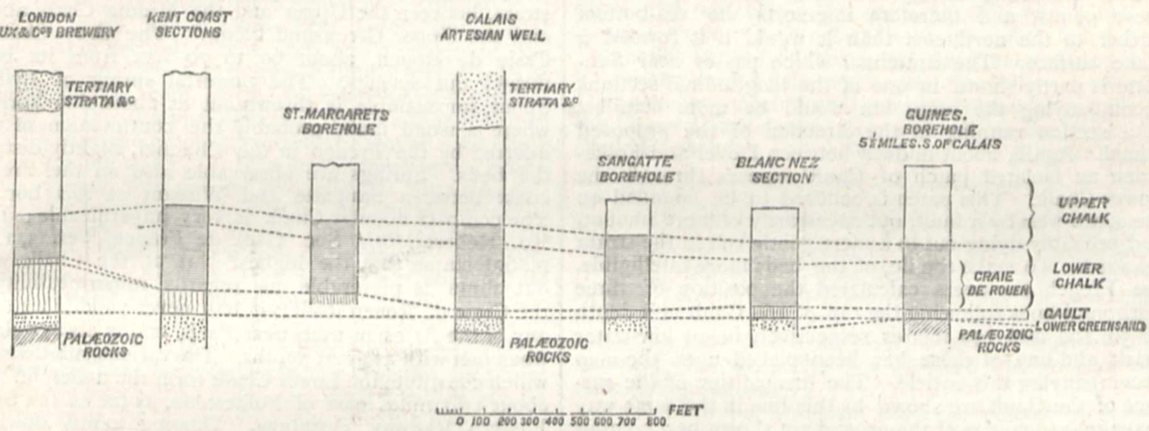

FIG. 3.—Sections showing the Persistence of the Lower Chalk.

The two schemes which are offered for tunnelling through the Chalk may be briefly stated as follows:—

1. The Channel Tunnel Company, with which Sir John Hawkshaw is connected, propose a tunnel starting from Biggin Street, Dover, with a gradient of 1 in 80, passing under the north spur of Dover Castle Hill, and thence continuing to a point on the shore known as the Fan Hole at a distance of 2 miles, 4 furlongs, 2·50 chains from Biggin Street, and at a depth of 115 feet below high water ordinary spring tides. From this point it will run across the straits to join the French tunnel, which commences near Sangatte, and as Sir J. Hawkshaw has always advocated a straight line of tunnel, we presume that such will be the case here.

2. The Submarine Continental Railway Company, with which Sir E. Watkin is associated, propose a tunnel connected with the South-Eastern Railway, about two furlongs west of Folkestone entrance of the Abbotscliff Tunnel by a tunnel descending at a gradient of 1 in 52 to the bottom of the No. 2 Shaft, near the west end of the Shakspeare Tunnel, at a depth of 126 feet below high water ordinary spring tides. From this point the tunnel will continue for about a mile towards the head of the pier in a direction slightly diverging from the shore, and finally curving round, will fall into the line of the French tunnel near Sangatte. In Sir John Hawkshaw's scheme the tunnel will start on the English coast in the lower part of the Upper Chalk, but will rapidly reach the Lower Chalk, and probably remain in it throughout. In that proposed by Sir Edward Watkin, the inclined plane leading to the tunnel, and the tunnel itself, will be driven from end to end in the same bed of grey chalk which constitutes the lower part of the subdivision of the Lower Chalk.

So far as our information goes at present it seems that the most serious obstacle will be water, and it is therefore on their relative liability to flooding that the proposed tunnels must be judged. In the Belgian Coal-field, where Coal-measures are worked under secondary strata full of water, it is found that those works are dry which "follow the vein," while those which cut across the strata are invaded by water. For the Coal-measures rise up to and end off in succession against the base of the secondary strata (which rest unconformably upon them), so that every bed, whether porous or not, is in contact with the water. It is clear then that a level, which cut across the strata, would run a far greater chance of intersecting a water-bearing rock than one which always followed the same bed. Now a precisely analogous position is held by the rocks which form the floor of the Channel relatively to the water which occupies it. The strata rising to the south-west crop out in succession in the sea-bottom, and, being for the most part bared by the scour of the tide, must be fully saturated with water. In an impermeable bed this would make little or no difference to mining operations, but to encounter a porous bed such as the Lower Greensand under such circumstances would be to tap a reservoir as inexhaustible as the sea itself. Fortunately an excellent water-tight barrier between this quicksand and the Chalk above is provided in the Gault. The Upper Greensand, which lies next above the Gault, is generally thin, but occasionally expands rapidly from almost nothing to six or eight feet, and, though as rapidly dwindling down again, it might under such circumstances conduct a large amount of water. The French engineers have tested it at intervals by borings in the drift-ways, and have observed that water rises from it in most cases. But it is generally too insignificant to prove dangerous.

That it would be advisable to choose the most favourable bed, and to follow it for the whole distance, if this were possible, is not to be denied. But a study of the map shows that to do this it would be necessary either to make at least two considerable curves in the tunnel, or else to make it rise and fall with the beds, which would probably be prejudicial to drainage and ventilation. For the form of the outcrop of the Gault shows that close to both shores the strata are bent upwards in the form known to geologists as anticlinals. The outcrops incline to the north-east in such a way that the Gault occupies a position in the line of prolongation of the Lower Chalk, indicating clearly that it is arched upwards at these points, and therefore intersects the sea-bottom further to the north-east than it would if it formed a plane surface. The anticlinal which passes near Sangatte is partly shown in one of the longitudinal sections accompanying the map, but would be more manifest in a section running in the direction of the proposed tunnel. Again, about midway between Dover and Folkestone an isolated patch of Gault appears through the Lower Chalk. This patch is believed to be bounded on the south-west by a fault, not necessarily of large amount, and probably dying out to a mere gentle roll in the strata seaward. To make the lie of the beds more intelligible, the French engineers calculated the position of three horizontal lines following the top of the Gault at a depth of 50, 100, and 150 mètres respectively below low-water mark, and one of these has been placed upon the map accompanying this article. The inequalities of the surface of the Gault are shown by this line in the same way that the inequalities of the ground are shown by a contour line.

The thickness of the Lower Chalk is such that in spite of these undulations in the beds a tunnel originally planned to run near the middle of the subdivision, might continue a straight course with an unchanged gradient, and still remain with its limits. But if running near the top a synclinal or downward bend would bring the Upper Chalk into the line of the tunnel, while if running near the bottom, an anticlinal or upward bend would bring in the Gault. It is obvious then that a tunnel traversing the lower portion of the Chalk, on encountering an anticlinal, would be compelled to bend towards the north-east in order to preserve a constant gradient, and at the same time avoid touching the Gault. It is believed that the route advocated by Sir E. Watkin is so planned as to round the two anticlinals described above, as occurring on either side of the Channel. It remains to be seen whether the form of the beds will admit of its being carried in a straight line, and at the same time in the bottom beds of the Chalk, for the remainder of the distance. In the route proposed by Sir John Hawkshaw, the effect of an anticlinal would be to bring up the lower beds of the Chalk into the line of tunnel, and would therefore not be unfavourable; a synclinal might probably bring down the Upper Chalk with flints, which, as will be shown subsequently, is not desirable.

A similar source of uncertainty exists in the possible occurrence of faults, that is, lines of fracture in the strata, on one side or other of which they have been vertically shifted. The Gault in mid-channel being presumably about 50 or 60 feet thick, a fault of this amount might bring the base of the Chalk and the top of the Lower Greensand face to face. The submarine mapping, however, if it can be trusted, shows that it is very improbable that there is a fault of this amount in the channel. A fault would displace all the beds of the Chalk in succession equally or nearly so, but its effect would be less perceptible higher in the system where chalk would be thrown against chalk, than at the base where chalk might be thrown against the Gault or Greensand. It remains to be considered which of the subdivisions of the Chalk is the most suitable for operations, and whether sufficient difference exists between the various beds to make the experience of the Belgian miners directly applicable to the Channel Tunnel.

The lower part of the Grey Chalk, the lowest subdivision of the Chalk as shown in the table, is universally stated to be very impermeable. Prof. Prestwich, in the "Water-bearing Strata of London," p. 63, states: "The lower beds of the Chalk are generally so argillaceous that the rock often puts on the character of an argillaceous clay, which on exposure to air and water softens to a tenacious mud. When first exposed its colour is bluish grey, but it becomes white or nearly so as it dries. . . . They everywhere form a generally impermeable mass of strata, between the Upper and the Middle Chalk above, and the Upper Greensand below." The Grey Chalk or Craie de Rouen, about 60 to 70 feet from its base, throws out springs. The powerful spring of Lydden Spout, for example, is thrown out at about this horizon, where a small fault, probably the continuation of that inferred by the French in the Channel, slightly disturbs the beds. Springs are observable also on the French coast between Sangatte and Wissant at this horizon. The compact nodular Chalk is very impermeable; Prof. Ed. Hébert (*Bull.* Soc. Geol. de France, Ser. 3, t. iv. p. 60) states that the highest part of the Chalk without flints is preferable as regards impermeability to the Craie de Rouen itself; it has never yielded water in any of the Artesian wells near Paris, and is always clayey when met with at great depths. The various sub-divisions which constitute the Lower Chalk form the undercliff from about two miles east of Folkestone, as far as the South Eastern Railway Terminus. Dipping gently down to the north-east, they were reached at 249 feet below sea-level at St. Margaret's Bay in Sir John Hawkshaw's borehole.[1]

The divisions of the Upper Chalk, namely the Chalk with flints, and the Chalk with few flints, differ chiefly in the mode of occurrence of the flints; in the former they occur in layers, in the latter they are scattered and far between. This difference is important, for the layers of flint often give rise to channels by which water circulates in the chalk. The chalk with a few flints occupies the beach from Dover Castle eastwards, until it is succeeded in due course by the Chalk with layers of flints. The former throws out a few springs, the latter a large number, and it is generally agreed that the Upper Chalk, and particularly the chalk with layers of flints, is the most heavily watered part of the formation.

The circulation of water in chalk takes place principally by means of fissures, the unfissured rock being of such close texture as to be practically impermeable. Prof. Prestwich, for example, has estimated the relative permeability of chalk and coarse sand to be as 1 to 6400. But when the fissures are numerous, and the rock contains layers of flints, the water is enabled to circulate with great freedom. The Upper Chalk is more liable to fissures than the argillaceous lower division, and for this reason excels it as a water-bearing formation.

[1] See sections (Fig. 2) accompanying the map. These have been copied with slight modifications from a paper by Mr. Topley in the *Quarterly Journal of Science* for April, 1872.

Now the principal difference between the two proposed routes consists in the fact that Sir E. Watkins' tunnel starts in the impermeable portion of the chalk with a view to following it all across, while Sir J. Hawkshaw's tunnel starts in the lower part of the Upper Chalk, and descends subsequently into the Lower Chalk, probably into that portion of it which, as stated by Prof. Hébert, is less permeable than the Craie de Rouen itself. The possible difficulties that may arise from following the base of the chalk too closely have already been pointed out. It remains to be seen how far the fact of starting in the Upper Chalk is prejudicial.

In spite of the vast quantities of water that have been obtained from the Chalk,[1] there are many instances of wells and deep bore-holes having failed to obtain a supply. A well at Dover Castle, 363 feet deep, or $1\frac{1}{2}$ feet below low-water mark, and with a tunnel 160 feet long at the bottom, can be pumped dry in three hours by a 30 horse-power engine (Statement by the Committee of the Channel Tunnel Company). Deep bore-holes, such as those at Harwich, Hampstead, Calais, and Grenelle, though traversing the whole Chalk system, have been unsuccessful, and many other instances might be quoted to show how uncertain is the amount obtainable by this means. The plan adopted at Ramsgate, and afterwards at Brighton in consequence of the supply from wells being inadequate, throws much light on the circulation of water in chalk. Mr. Easton (Brit. Assoc. Rep. 1872) states that a well was sunk, and the direction of the fissures having been ascertained, a tunnel was driven at right angles to them, so as to intercept the greatest number in the shortest distance. Such a tunnel driven under Goldstone Bottom traversed 160 feet of solid chalk without finding water. It then encountered an enormous fissure yielding 1000 gallons per minute. This was followed at about the same interval by another of about equal capacity. At the Lewes Road the fissures were about 30 feet apart and yielded about 100 to 150 gallons per minute. At Ramsgate the supply was obtained by driving parallel to the shore at about low water-mark. The fissures were observed by Mr. Easton to run at about right angles to the coast line, so that it is clear that a tunnel might have been driven in this direction for a long distance without cutting a fissure. That a tunnel can be driven even in the most favourable situation for tapping water has been proved by Sir J. Hawkshaw, who, in the discussion which followed Prof. Prestwich's paper (*Proc.* Inst. C.E. xxvii.), stated that "he was now completing at Brighton a tunnel of $5\frac{1}{4}$ miles in length, wholly through the Upper Chalk and below the level and within a short distance of the sea, There was a large amount of water from land-springs. The quantity of water pumped varied from 8,600 to 10,000 gallons per minute. This was a large quantity, but it did not prevent the tunnel from proceeding." The same length of tunnelling taken seawards at a greater depth might have carried the works clear of these difficulties, for there is reason to believe the fissures are most numerous and widest above or near the sea-level.

These fissures, originally mere cracks due to unequal contraction or expansion in the mass of the chalk, owe their enlargement to the passage of water through them, acting partly mechanically by erosion, partly chemically by dissolving the carbonate of lime. Although they are met with at considerable depths, as for instance in the borehole at St. Margaret's Bay, where a cavity of 3 feet depth, and filled with salt water, was found at 209 feet, yet they are most numerous where the circulation is most active, namely, about the water-level. It is at this level, as well as above the outcrop of an impermeable bed, that the largest inland springs occur, and it is at the sea-level that the largest quantity of water escapes from the cliffs on the coast. Beneath the waters of the Channel there may be but little movement in the rock-water, and what fissures or faults may exist, as well as the channels following the layers of flints are probably more or less choked from long disuse. While therefore it is not likely that the approaches to a tunnel can be made under the coast in the Upper Chalk without meeting with much water, it does not necessarily follow that the quantity will be so great as to be utterly unmanageable. That it is expected to be considerable may be inferred from a statement by Sir John Hawkshaw in the discussion before referred to, that the engines used in the Brighton tunnel "were, in the aggregate, of 150 horse-power, but provision had been made in estimating the possible cost of the Channel tunnel, for engines of about 2000 horse-power."

Finally, it may be stated that the works, so far as they have gone, have confirmed the expectations formed as to the character of the rocks. The shaft at the west end of Abbot's Cliff Tunnel has been taken to a depth of 160 feet, and a drift-way carried in the Lower Chalk for 1100 yards in the line of the tunnel proposed by Sir E. Watkin, without meeting water. On the French side two shafts have been sunk near Sangatte to a depth of 280 feet, entering the Craie de Rouen at the sea-level, and a tunnel has been driven in a north-easterly direction at about 170 feet below the sea-level, with trial holes at intervals to the Gault, which is about 7 feet below. A little water issues from these, but the total amount that has to be pumped does not exceed 80 gallons a minute. Up to the present time no further trials have been made in the Upper Chalk at the spot selected for the works by Sir J. Hawkshaw. A. STRAHAN

[1] In the discussion on a paper by Mr. Lucas (*Proc.* Inst. C.E. xlvii.) Mr. Homersham stated that 11,000,000 to 12,000,000 gallons daily had been taken from the chalk in an area of 150 square miles about London for some years.

SIR CHARLES WYVILLE THOMSON

THE news of the death of Sir Wyville Thomson, on the 10th instant, from the effects of paralysis, will be received with general regret. Sir Wyville was only in the 53rd year of his age. On the return of the *Challenger*, we gave so full an account of Sir Wyville's life and work (vol. xiv. p. 85) that we need not go over the same ground again.

Charles Wyville Thomson was a descendant of an old Scottish family which had long resided at Bonsyde, Linlithgow. His father was a surgeon in the service of the East India Company. Born at the family residence on March 5, 1830, Wyville Thomson became, at the age of twenty-one, a lecturer on Botany in King's College, Aberdeen. In 1853 he became Professor of Natural History in Queen's College, Cork; but he had only been there a year when he succeeded to the Chair of Mineralogy and Geology in Queen's College, Belfast. In the expeditions of the *Lightning* and *Porcupine* in 1868 and 1869 he took part, and the discoveries then made in regard to the fauna of the Atlantic Ocean he subsequently gave to the world in a work entitled "The Depths of the Sea." On the resignation of Prof. Allman, Prof. Thomson was elected Regius Professor of Natural History in the University of Edinburgh, where his abilities as a lecturer raised the class of zoology to a position of great importance, the numbers attending it being probably unequalled. Of the famous expedition in the *Challenger*, Prof. Thomson was appointed the scientific chief. Leaving England in 1872, the exploring party was absent for three and a half years, during which time 68,890 miles were traversed, and systematic observations made at 362 stations in the open sea, notes being also made on land and in shallow water, as opportunity offered. The natural history and other collections obtained were very extensive. These large collections were from time to time sent home to Edinburgh, where the head office of the expedition was subsequently established; and it was only appropriate that as he had gathered them from the previously "unfathomed depths of ocean" in all climes, the direction of the work of describing and reporting upon the specimens should be entrusted by the Treasury to Prof. Thomson. For the last two years, however, Prof. Thomson has not been able to do much in connection with this important work, which has, in consequence, largely devolved upon his able first assistant, Mr. John Murray, who, in the beginning of the present year, was on account of the state of health of his chief, appointed director.

Immediately on his return to this country from his extended voyaging, Prof. Thomson's services to the cause of science were acknowledged in various quarters. On June 27 he received the honour of knighthood; the Royal Society of London awarded him one of its gold medals; and in July of the same year he, along with the other members of the scientific staff of the *Challenger*, were entertained at a banquet in Edinburgh, at which the toast of the evening was proposed in eulogistic terms by Prof. Huxley. Subsequently, when, along with Emeritus Professor Balfour, he went as the representative of the Edinburgh Senatus to Upsala on the occasion of the tercentenary of that ancient University, the King of Sweden created him a Knight of the Order of the Polar Star. Sir Wyville was also an LL.D. of Aberdeen, a D.C.L. of Dublin, a Doctor of Philosophy of the University of Jena, a D.Sc., a Fellow of the Royal Societies of London and Edinburgh, of the Linnean Society, and of various foreign and colonial institutes. In 1877 Sir Wyville was appointed to deliver the Rede Lecture at Cambridge; and in 1878 he presided over the Geographical Section of the British Association at its meeting in Dublin. In addition to numerous memorials on zoological subjects, and contributions to the proceedings of the scientific societies with which he was connected, Sir Wyville also wrote a preliminary account of the general results of the *Challenger* Expedition, which was published in two volumes under the titles of the "Voyage of the *Challenger*—The Atlantic."

After his return in 1876 from the voyage of the *Challenger* Expedition, it was remarked that his long spell of travel had not brought increased physical vigour; but it was not until 1879 that his condition gave his friends serious cause for uneasiness. In June of that year he was prostrated by an attack of paralysis, and unable to conduct his class of Natural History in the University of Edinburgh, and the important undertaking in which he was engaged, of directing the working out of the *Challenger* researches, with the view of furnishing to the world a complete record of the results, had to be laid aside, only to be intermittently touched again before the time came when he had to resign it entirely into other hands. In October last he resigned his Chair in the University, and we believe that arrangements had just been completed by the Senatus in respect to his retiring allowance. Some four months ago he had a second paralytic attack, and since then his health has been feeble. He died on Friday morning at three o'clock.

The departments of zoology to which he devoted most attention were those which included the corals, crinoids, and sponges, and upon these his opinion was regarded as of great weight. In the University he was held in esteem by his colleagues of the Senatus, and among the students he was exceedingly popular. In private life he was regarded by his friends as possessed of a kindly and hospitable disposition.

Sir Wyville Thomson married a sister of the late Mr. Adam Dawson of Bonnytoun, Linlithgowshire, for some years Provost of Linlithgow, whose father also occupied the same honourable position for the greater part of his life. He is survived by Lady Thomson and one son, an M.A. of the University of Edinburgh, who is at present engaged in the study of law.

THOMAS ROMNEY ROBINSON, D.D.

THOMAS ROMNEY ROBINSON, D.D., F.R.S., whose death we recorded in our last issue, was born in Dublin on April 23, 1793. His abilities and genius seem to have been manifested at a very early age, and his first appearance as an author dates so far back as 1806. On that occasion his venture was entitled "Juvenile Poems by Thomas Romney Robinson, to which is prefixed a short account of the Author by a Member of the Belfast Literary Society:" Belfast, 1806. The book contains a number of poems written by the author at various ages below thirteen. Dr. Robinson's last publication is in the *Philosophical Transactions* for 1880, and it must be regarded as a curious circumstance in literary history that an interval of three-quarters of a century should have elapsed between Dr. Robinson's first appearance as an amateur and his last.

In the year 1814 Dr. Robinson was elected a Fellow of Trinity College, Dublin, and he was for several years engaged in lecturing in the University as Deputy Professor of Natural Philosophy. In connection with his labours as a teacher he published in 1820 a volume entitled "A System of Medicine for the use of Students in the Dublin University."

After a residence for nine years at Dublin University, Dr. Robinson accepted the living of Enniskillen, which was in the gift of Trinity College. Robinson's career in the University was thus finished the year before Humphrey Lloyd, the late Provost, was elected to a fellowship.

Dr. Robinson did not long remain Rector of Enniskillen. In the year 1824 he exchanged the living of Enniskillen for that of Carrickmacross; and of his ecclesiastical career there is little further to note, except that about half a century later (in the year 1872) he was nominated a Prebendary of St. Patrick's Cathedral, Dublin, and that several of his sermons have been published.

Dr. Robinson is principally known to fame by his connection with the Armagh Observatory. The observatory at Armagh was founded in 1793 by Primate Robinson. The endowment of the observatory, as well as that of a public library, arose out of Primate Robinson's scheme of forming at Armagh a university which might serve for the education of the North of Ireland. It is needless to say that the greater part of the Primate's beneficent scheme was never realised. At his death the meridian instruments he had ordered for the observatory seem to have been countermanded by his heirs. The two succeeding primates had but little interest in science, and it was not until they were succeeded by Lord John George Beresford, the late Primate, that any further steps were taken. Primate Beresford presented to the observatory a transit instrument, a mural circle, and an equatorial reflector of fifteen inches' aperture. The first of these was erected in 1827, and the last in 1835. It was in the year 1824 that Dr. Robinson was appointed director of the Armagh Observatory. He threw himself into the work of practical astronomy with the greatest zeal and success, and the celebrated "Armagh Catalogue" is a noble monument of his assiduity and skill. This catalogue, though not published until 1859, contains many observations of stars between the years 1830-40, of which we possess few contemporary observations. On this account the Armagh Catalogue has a distinct value, and it has been much used by Argelander in his investigations of the proper motion of 250 stars in vol. vii. of the Bonn Observations.

The mural circle at Armagh was subsequently furnished with a new telescope having an objective of 7 inches' aperture, and with this 1000 of Lalande's stars, nearly all between 6·0 and 7·5 magnitude were re-observed in 1868-76, and the results have been published in the *Transactions* of the Royal Dublin Society, new series, vol. i.

Dr. Robinson's determination of the constant of nutation also deserves notice, though for reasons which need not now be discussed it has never come into practical use among astronomers.

The celebrated cup anemometers, now so extensively used, are an indication of the practical skill and ingenuity by which Dr. Robinson was distinguished. The very latest scientific labour of his long life was a redetermination of the constants of the cup anemometer. This was accomplished by experiments on a very large scale, in the dome of Mr. Grubb's workshops, at Dublin. The results of these labours have been published in the *Phil. Trans.*, 1878–1880.

Considering that Dr. Robinson was an author before the battle of Trafalgar, that he was elected a Fellow before the battle of Waterloo, and that he was made director of the Armagh Observatory within a year or two of the death of Sir W. Herschel, it is not surprising to find that Dr. Robinson's scientific friends and associates belonged mainly to the past generation. In that past generation, Dr. Robinson occupied a distinguished and remarkable position. He was intimately associated with the late Earl of Rosse in all those memorable experiments which culminated in the great reflector at Parsonstown. He was the friend of Sir James South, of Sir William Fairbairn, and of many other celebrities. His wide sympathy, his gentle and invariable kindness, his wondrous stores of knowledge, his charming powers of conversation, his brilliant eloquence, were qualities universally recognised, and caused him to be welcomed and beloved in many circles besides those purely scientific.

NOTES

WE learn that Dr. Huggins obtained a photograph of the spectrum of the great nebula in Orion on the 7th inst., and that in addition to known lines, it shows a strong line in the ultra-violet.

THE death is announced, at the early age of forty-six years, of Prof. A. Freire Marreco, who filled the Chair of Chemistry in the Newcastle College of Science. Prof. Marreco had a considerable reputation as a working chemist, and did much to promote the cause of science in the north of England.

THE death is announced of Herr J. J. Sievers, the well-known astronomer, who died at Altona on February 22 last, aged seventy-seven.

AT the dinner given by the Lord Mayor on Saturday to a large number of gentlemen who have shown an interest in the Smoke Abatement Exhibition, Mr. Shaw Lefevre pointed out that we had advanced nothing in the cure of London fogs since the days of Evelyn, who gave great attention to the subject. Mr. Ernest Hart, the Chairman of the Committee, spoke of the loss by dirt and the loss by darkness, amounting to many millions, occasioned by smoke and fog; and, referring to the late exhibition, said the scientific results were most satisfying and encouraging. Many excellent inventions proved the perfect practicability of abating smoke from domestic grates, and especially from kitcheners (which were now the greatest offenders), and there was not an industry in the country which would not be benefited by an application of some one or other of the exhibits. Mr. Hart adduced some striking statistics to show the serious loss of life by the recent London fogs, and stated that during these fogs he had telegraphed to various places just outside London, and found that the weather was clear and beautiful. Surely some earnest effort will now be made to abate the serious nuisance.

IN a note on the appointment to the Edinburgh Natural History Chair, the *Spectator* of March 11 says: "There is a great, though not obtrusive, dissatisfaction in Scotch educational circles, and even beyond them, at the unprecedented delay of the Home Office in filling up the Chair of Natural History in the University of Edinburgh, which Sir Wyville Thomson long ago resigned. The post is the academic blue riband of natural science in Great Britain. The annual emoluments, between fees and endowment, come to close upon 2000*l*. The work of the Chair is not arduous, and the occupant has the advantage of living in the most charming of provincial cities, and of being lionised by its society. Some of the most eminent biologists in the United Kingdom, including the Professors of Natural History in the three other Scotch Universities of Glasgow, Aberdeen, and St. Andrew's, are candidates for the Chair. But Lord Rosebery, with whom, as Under-Home Secretary, the appointment virtually lies, is understood all over the country—we hope falsely—to be desirous to appoint Prof. Ray Lankester, of University College, whose cause is actively championed by Prof. Huxley. Able as Prof. Ray Lankester is, we should greatly regret, in the interests of Scotland, to see the appointment of so very relentless a champion of vivisection, nay, even of a large extension of vivisection, to a Chair of influence in Edinburgh." This is a fine instance of good taste and sound judgment. If Prof. Lankester's high qualifications are recognised, Lord Rosebery is not likely to be influenced by a bye question, urged especially in such a way from such a quarter.

THE Society of Chemical Industry has proved so far successful that they have been able to begin the publication of a *Journal* intended as a "Monthly Record for all interested in Chemical Manufactures." The first number was published in January, and contains various reports connected with the Society and its branches, a paper on Artificial Indigo, by Professors Roscoe and Baeyer, and a number of interesting notes. Prof. Abel's address at the opening of the London section is of great interest as showing in a great variety of instances the intimate dependence of manufactures on success in improvement of chemical processes, and advance in chemical research. "It is, indeed, I submit," Prof. Abel said, "the special duty of this section of the Society to demonstrate, by its activity, how intimately interested in the advancement of applied chemistry, physics, and mechanics, are a large number of trades which are practised in the metropolitan area, and how closely allied to each other in regard to their interests in the development of chemical and engineering science are many trades which, to the general public or the superficial observer, would appear to have little interest in common. Certainly, in no part of Her Majesty's kingdom, I may say of the universe, can be found congregated together so great a variety of important manufacturing trades—all of them deriving direct advantage from the advance and the application of science—as exist within our metropolitan area and its immediate environs. Thus, among those whose trades, pursued in and around the metropolis, may be considered to bring them within the possible scope of activity of a society founded for the advancement of chemical industries, we have the manufacturers of definite chemical products, of drugs, and of pharmaceutical preparations, of white lead and other mineral colours, of varnishes and lacquers, of all the various products of coal-tar distillation, from creosote and pitch to dyes of the greatest beauty and purity; of manures, of cements, of candles, soaps, and lubricants; the refiners of sugar, of oils, and of metals; brewers, distillers, tanners, makers of glue and size, of pottery, stoneware, and glass, of gunpowder and pyrotechnic compositions, of waterproof goods and insulating materials. Extensive as this list is, it might probably be added to considerably." It is evident there is ample scope for the work of such a society as this, and on its present lines it is likely to do much good.

PROF. HAECKEL, of Jena, has now concluded the zoological work he was conducting on the south coast of Ceylon during two months, and has sent over fifty cases with natural history collections to Jena. His researches on the Ceylon coral reefs were highly successful, and led to the discovery of many new species. During February Prof. Haeckel visited the mountains, and by now is probably on his way back to Jena.

THE existence in Northern Russia, and especially in the neighbourhood of St. Petersburg, of a bottom-moraine, like that which covers Sweden, Finland, North Germany, and the north of Britain, was long doubted. The researches of Prof. Inostrantzeff along the diggings of the new Ladoga canal (*Memoirs* of the St. Petersburg Society of Naturalists, vol. xii.) do not leave, however, any doubt on this subject. The Devonian rocks which appear between the rivers Syass and Svir (the geological map of Prof. Helmersen having to be modified in this respect) are covered with a thick sheet of typical bottom-moraine. It consists of a grey or reddish, unstratified and earthy mass of sand and clay containing both small rubbish and great boulders, sometimes 10 feet in diameter. The boulders consist of granite, gneiss, sandstone, and slates, these last being most numerous, and exhibiting beautiful polished and scratched surfaces. At some places the thickness of the bottom-moraine reaches 14 feet, and it is interesting to observe how the advance of the ice-sheet has folded and plaited the ends of the Devonian strata, the moraine matter being sometimes thrust between them. The washed and stratified sands which cover the bottom-moraine contain numerous remains of prehistoric man. These researches of Prof. Inostrantseff are completely confirmed by those of M. Dokcutchaieff, who has explored the ridges of sands and gravels (*osar*) on the eastern coast of the Gulf of Finland. While several of them are simple dunes, kames, or eskers, others are completely composed of typical glacial gravel (*krossstensgrus* of Swedish geologists), or of the same gravel covered with a mantle of more recent stratified sands. Both are of morainic origin.

AT a recent meeting of the Asiatic Society of Japan, says the *Japan Mail*, Prof. John Milne, of Tokio, read a paper on the *Koro-pok-guru*, or Pit-dwellers of the Island of Yeso. This name is that used by the Ainos, and means, literally, "people having depressions." According to the Aino accounts this race lived in huts built over holes, and knew the art of pottery. Mr. Milne found and examined pits on a small island near Nemuro, the north-east port of Yeso, and among the Kurile Islands. Near them were found flint arrow-heads and fragments of earthenware. The Japanese say that the pits, which are rectangular in shape, were inhabited by a race of *Kohito*, or dwarfs, which was exterminated by the Ainos. In the extreme north of the Kuriles Mr. Milne met with the aborigines of these islands dwelling in huts built over pits, which were, in general appearance, identical with the pits found farther south. In Saghalin and Kamschatka also, certain tribes dwell in pits. The general conclusion to which the writer comes is that the modern representatives of the pit-dwellers are the Kurilsky, and some of the inhabitants of Saghalin and Kamschatka, who, like the Esquimo of the Atlantic sea-board, had in former times extended much farther south. Several facts were also adduced to show that the shell-heaps of Japan were of Aino formation. Mr. Milne suggested that the hairy Ainos were connected with the hairy Papuans, who at one time extended from their present home in the south in a continuous line through the Philippines to Japan. Malay races invaded this line in the Philippines, so that all that remain of the aboriginal stock are the hairy Aeta. In Formosa, Oshima, Satsuma, and other parts of Japan, links of the hairy, large-eyed, round-faced Aino type are still to be found. The modern Japanese invaded the line from the direction of Corea, and as they exterminated or drove the Aino towards the north, the Aino in his turn pressed upon the *Koro-pok-guru*, who retreated to more northern regions, leaving behind him, as indications of his former presence, the pit-like depressions found in so many parts of Yeso. In the discussion which followed, Mr. Satow remarked that the old Japanese chronicles indicated the presence in Eastern Japan of other tribes of barbarians besides the Ainos. He agreed with Mr. Milne's theory of an early Mongoloid immigration, which probably came by way of the Korean peninsula, and was established in the western provinces before the advent of the ancestors of the ruling family, who entered Japan from the south of Kiushiu, and were probably of Malay origin.

A SOCIETY for the study of the French language which has been established amongst the Japanese in Tokio, is about to publish a complete history of the country in French.

THE annual prize of the Russian Academy of Sciences, bearing the name of Academician Brandt, has been awarded to Prof. K. Meller, for his researches on the Russian Coal-basins. The prize of Prof. Bouniakovsky remained unawarded, few larger works of value having been published last year in Russia in the Natural Sciences Department.

IN a paper on "Ozonised Air as an Anæsthetic," by Dr. C. Binz, of Bonn, in the Berlin *Medical Journal* (1882, 1 and 2), the author brings forward a number of interesting experiments on the effect of breathing small amounts of ozone. The gas was in all instances employed mixed with air and produced by the silent discharge. The effect on small animals was very marked, first becoming somewhat unquiet, and then the breathing less frequent, a state of torpor finally ensuing. No appreciable action on the heart appeared to have taken place at this stage. The bodily heat however becomes much lowered, and irritation and inflammation of the air-passages, causing vomiting, ensuing. The experiments with human beings show considerable differences in effect on individuals. Generally sleep ensued in from seven to twenty minutes, being preceded by a feeling of greater ease in breathing. The sleep was generally also very deep, being followed by a tired sensation for some minutes. The continuation of the experiments demonstrated, however, that although ozone is not by any means so irritating and destructive in its effect on delicate membranes as hitherto stated, it would be quite impossible to employ it as an anæsthetic to replace nitrous oxide.

A RICH discovery of Lacustrine relics has been made at Steckborn, on Lake Constance. They consist of flint and bone implements, pottery, bones of animals now extinct, and a quantity of wheat and oats. The relics have been placed in the Frauenfeld Museum.

DURING last year the Council of the Meteorological Society, having regard to the rapid progress of late years in statistical meteorology, and the uncertainty that still prevails regarding important questions relating to the physics of the atmosphere, considered it desirable that the Society should supplement the ordinary observations by a series of well-conducted experiments destined to throw light on such questions as the vertical decrement of temperature, the rate of ascension of vapour, the height of cloud-strata, the variation in the velocity of the wind at different elevations, &c. Steps have been taken during the past week to make observations on the first of the questions by the placing of thermometers at the summit and base of Boston Church Tower, which is 270 feet high. This tower is admirably situated for making such experiments, as it is isolated and free from any obstructions, and the ground is quite flat for miles round. By permission of the vicar, Canon Blenkin, the instruments have been placed as follows:—At the summit one of Dr. Siemens' electrical thermometers (kindly placed at the Society's disposal by Messrs. Siemens Bros. and Co.) and an ordinary thermometer are mounted in a small screen fixed to one of the pinnacles of the tower; on the roof of the belfry, which is 170 feet above the ground, a Stevenson screen has been mounted containing maximum, minimum, dry and wet bulb thermometers.

In the churchyard, another Stevenson screen has been fixed containing a similar set of thermometers, for comparison with those above. All the thermometers will be read every morning at nine o'clock. The electrical thermometer consists of a coil of wire wound round a cylindrical piece of wood inclosed in a small brass tube, a third wire is joined to one of the wires, and the three insulated by gutta-percha, form a light cable which is brought down to the base of the tower and connected to a galvanometer, the terminals of which are in connection with the two poles of a six-cell Leclanché galvanic battery. The instrument is read by depressing a key, which causes the needle of the galvanometer to deflect; a pointer or vernier (moving a contact roller upon a wire in a circular groove) is then pushed to the right or to the left upon a divided scale until the needle remains stationary on the zero point, when the electrical resistance of the wire is measured upon the scale. The number indicated by the vernier is then read off, and by referring to a table of equivalents the actual temperature in degrees of Fahrenheit is readily ascertained. Simultaneous readings of the electrical thermometer at the summit of the tower and of the dry bulb thermometer in the churchyard will be made frequently during the day by the verger of the church.

A RUSSIAN naval officer has invented a very ingenious apparatus for ascertaining the depth of the sea without the use of a costly and heavy line. Indeed, no line at all is used. The instrument consists of a piece of lead, a small wheel with a contrivance for registering the number of revolutions, and a float. While the apparatus sinks, the wheel revolves, and the registered revolutions indicate the depth. When the bottom is reached, the lead becomes detached, the float begins to act, and the machine shoots up to the surface, where it can easily be fished up by a net and the register read off.

PROF. WEGMÜLLER, the eminent Munich sculptor, is hard at work at the monument of Baron Justus von Liebig, the eminent chemist, which will be erected in the Public Gardens at the Maximilian's platz of Munich. It is of Carrara marble and over life size.

THE enterprising people of Paisley, near Glasgow, are to have a popular observatory attached to their Free Library and Museum, mainly through the liberality of Mr. Thomas Coats, who, with the assistance of Prof. Grant, of Glasgow, has not only purchased a suitable equatorial with all necessary adjustments, and a cupola, but is erecting a tower for the reception of the instrument. Similar institutions in the provinces might take a hint from Paisley.

M. DE FREYCINET, the French Minister of Public Affairs, has declared himself a candidate for the next election to the Academy of Sciences, to fill the seat vacated by M. de Bussy's recent death. His claim is grounded on the publication of books relating to engineering and the integral calculus. M. Paul Bert, the late Minister of Public Instruction is also offering himself for election, but in the section of Surgery and Medicine.

BAEYER, in continuing his investigations on indigo (*Berichte*, xv. 50), arrives at probable structural formulæ for the molecules of this compound and some of its derivatives. Some light has been thrown on chemical changes which occur in the manufacture of *yellow prussiate of potash* by the observation of Remsen (*Amer. Chem. Jnl.*, iii. 134), that a cyanide of iron is formed when iron, which has been reduced by hydrogen and organic matter, is heated with metallic sodium in an atmosphere of hydrogen.

THE *Panama Star and Herald* of Monday announces that an earthquake has occurred in Costa Rica, by which the towns of Alajuela, San Ramon, Grecia, and Heredia have been destroyed. It was at first stated that several thousand persons had perished, but according to later information, the loss has been grossly exaggerated.

FROM April 11 to 16 a Pedagogical Congress will meet at the Sorbonne, under the presidency of the French Minister of Public Instruction, who will be, as in former years, M. Ferry. The male public teachers will, as in 1881, send their delegates; but a great innovation will take place—the female teachers will for the first time enjoy the same privilege. The *Journal Officiel* has already published the programme of questions which will be discussed in this characteristic session.

MOVEMENTS of the ground appear to be now going on in the Jura. M. Girardot has lately pointed out that villages that were invisible to each other at the beginning of the century, and even thirty to forty years ago, are now visible. First the roofs appeared, then (in part) the walls. Such is the case with the villages of Doucier and Marigny, near Lake Chalain. Important changes have been observed even within ten years.

A LARGE meteorite fell at Mirotch Planina (Eastern Servia), on February 21 last.

WE have on our table the following books:—A Monograph of the Insectivora, Systematic and Anatomical, by G. E. Dobson (Van Voorst); Leçons sur L'Electricité et le Magnétisme, by E. Maxart and J. Joubert (G. Masson); The Use of Gas as a Workshop Tool, by Thos. Fletcher, Warrington; Contributions to Meteorology, by Elias Loomis; Punjab Customary Law, 3 vols., by C. L. Tupper (Quaritch); Geology of the Counties of England, by W. J. Harrison (Kelly and Co.); The Sun, by C. A. Young (Kegan Paul and Co.); Hesperothen, 2 vols., by W. H. Russell (Low and Co.); A Plea for the Rain-band, by J. Rand Capron; Pioneering in the Far East, by Ludwig Verner Helms (W. H. Allen); Ferments et Maladies, by E. Duclaux (G. Masson); Commercial Organic Analysis, vol. ii., by A. H. Allen (Churchill); Manitoba, by Rev. G. Bryce (Low and Co.); Electric Lighting, 3rd edition, by Killingworth Hedges (Spon); Blackie's Imperial Dictionary, vol. ii.; Preparation for Science Teaching, by John Spanton (Griffith and Farran); Ueber die Dauer des Lebens, by Dr. A. Weismann (Fischer, Jena); Die Magneto und Dynamo-elektrischen Maschinen, by Dr. H. Schellen (Dumont-Schanberg); Acoustics, Light, and Heat, by N. E. William Lees (Collins); Experimental Chemistry, Part I., by Prof. J. Emerson Reynolds (Longman); Geology and Resources of the Black Hills of Dakota (Government Office, Washington, D.C.); Atlas to the same; Magnetism and Electricity, by R. Wormell (Murby).

THE additions to the Zoological Society's Gardens during the past week include a Water Vole (*Arvicola amphibius*), British, presented by Mr. W. K. Stanley; two Common Buzzards (*Buteo vulgaris*) from Scotland, presented by Mr. W. M. Baillie; a —— Harrier (*Circus*, sp. inc.) from South Africa, presented by Mr. Cole; a West African Python (*Python sebæ*) from West Africa, deposited; a Muscat Gazelle (*Gazella muscatensis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—Prof. Julius Schmidt has published his variable-star results for 1881, which evince the same assiduity of observation as in so many years past. Seven minima of Algol were determined; the last occurred on November 27, at 11h. 8·5m. M.T. at Athens. Of Ceraski's variable U Cephei, a minimum took place May 13, at 11h. 0·2m., and one on November 26, at 9h. 4·1m.—the interval corresponding to 79 periods of 2d. 11h. 49m. 25s. A minimum of Mira Ceti (a phase of which we have comparatively few observations) occurred on March 2. χ Cygni attained a maximum July 17·0, brightness 6·5; this date is nearly three months later than the epoch assigned by Argelander's formula in the seventh volume of the Bonn Observations, as indeed has been the case for some years. For Pigott's variable R Scuti, Prof. Schmidt finds maxima at August 7·2 and October 31·2, and minima at July 4.9 and September 23·6. He has many epochs for the short-period variables, δ Libræ, δ Cephei, β Lyræ, η Aquilæ, and ζ Geminorum.

THE TOTAL SOLAR ECLIPSE OF MAY.—The central line in the eclipse of May 17 passes near to Teheran, in which longitude the duration of totality will be within five seconds of the maximum. Taking the position of the Indo-European Telegraph Station in longitude 3h. 25m. 41·7s. east of Greenwich, and latitude 35° 41′ 7″, as determined by the Russian General Stebnitsky, it appears that the central line will pass between nine and ten English miles south of the station. At Shanghai, the eclipse is partial, magnitude 0·996 at 5h. 21m. p.m. local mean time: the central line runs some fifteen or sixteen miles north of that place: the sun at an altitude of 17°. At the observatory of Zi-ka-Wei, the eclipse is also partial, magnitude 0·994. In Cairo, upwards of nine-tenths of the sun's diameter are covered.

GALLE'S METHOD FOR SOLAR PARALLAX.—The present year will afford two favourable opportunities of applying the method suggested by Prof. Galle for determining the sun's parallax, viz. the observation at distant stations of the minor planets when they approach near the earth. Mr. Gill has taken steps to secure such observations about the opposition of *Victoria* on August 24, and that of *Sappho* a month later. In the case of the former, the distance from the earth at opposition will be 0·891 (the earth's mean distance being taken as unity), the declination 8° N., and the magnitude 8·3; in the latter case the distance will be 0·847, the declination 12½° N., and the magnitude 9·2. Ephemerides of both planets about opposition will be found in the *Berliner Astronomisches Jahrbuch* for 1883.

THE TEMPLE OBSERVATORY, RUGBY.—We have received the Report of this Observatory for the year 1881. As in former years, the principal instrument, an 8¼ inch refractor by Alvan Clark, has been employed on observations of double stars, and 210 complete sets of measures of distance and position were made in the past year. Mr. Seabroke, the honorary curator, with the assistance of Mr. Hodges, has completed a summary of the work in the three years 1878-80, which forms part of vol. xlvi. of the *Memoirs* of the Royal Astronomical Society recently issued. Some attention has been given to the determination of the motion of approach or recession of stars, though with the double-star work and the hour each fine evening, through part of the year, devoted to members of the school, little time remains for that class of observation, more especially as the observers engaged follow their ordinary vocations during the day, and very late hours are thus precluded.

GEOGRAPHICAL NOTES

THE mail from India brings the news of the death of a very meritorious Indian servant, and one of the most remarkable of living travellers—Nain Singh, or the Pundit No. 9, as he was officially known, a hillman of the Khsettriya, or warrior caste. Nearly thirty years ago he offered his services as native assistant to that intrepid but unfortunate explorer Herr Schlagentweit. In the year 1863 he became one of the staff of trained native explorers under the orders of Col. Montgomerie of the Trigonometrical Survey, and it was in this capacity that he earned his reputation. The experience which Nain Singh had acquired with Herr Schlagentweit was held peculiarly to fit him for employment in the most interesting department of Indian geographical research—the exploration of the Trans-Himalayan regions. The success which attended his journeys beyond the great northern mountain barrier of India exceeded the expectations of even the talented officer who had specially trained him for the work. In 1866 he determined the true position of Lhasa; in 1867 he visited the celebrated gold mines of Thok Jalung, and seven years later he began his most celebrated tour of all, that through Thibet from west to east. During this he visited the capital of the Dalai Lama, took numerous observations, and threw much fresh light on the question of the Sanpu River, and whether its lower course is the Brahmapootra or not. This exploit closed Nain Singh's public career. He was awarded the Royal medal by the Royal Geographical Society, and the Indian Government granted him a small estate, where he died towards the end of last January. There have been few native Indian officials who have done more useful or more durable service than the explorer Nain Singh.

AT the meeting of the Geographical Society on Monday Mr. D. W. Freshfield, the secretary, read a paper on a three months' journey in the Makua and Lomwe countries, by Mr. H. E. O'Neill, who succeeded the late Commander Musters as consul at Mozambique. Mr. O'Neill evidently made a very successful journey of 600 miles through country previously almost unknown, and his paper forms a contribution to geography which is of some importance, though it hardly comes up to our ideas of what a good geographical paper should be. The most telling part of it is that which deals with the manners and customs, &c., of the Makua race. Though it has been reported that Mr. O'Neill actually sighted the Wamuli Peak, said by the natives to be covered with perpetual snow, he himself distinctly says that, although its position was pointed out to him, he could not clearly distinguish it. To some future traveller, therefore, will fall the honour of actually being the first to *see* the snow-clad peak, if it really exists, though no doubt he will have been very nearly run by Mr. Maples on one side and Mr. O'Neill on the other. Towards the conclusion of his paper, Mr. O'Neill makes some useful observations on the commercial capabilities of the country traversed, from which it would appear that there is a good opening there for imports, but the economic products are at present few.

THE most important contribution in the March number of the Geographical Society's *Proceedings* is Mr. Last's account of his journey from Mamboia into the Nguru country, East Central Africa. On this occasion Mr. Last had his wife with him, and travelled, in a little over three weeks, some 250 miles, of which the whole of the region between Mguru and Kibauti was new to Europeans. Mr. Last sent home a rough map of his journey, on which he also laid down the roads and places passed in 1880, as most of them are not shown on previous maps of East Africa, and from this a map on the scale of nearly twelve miles to the inch has been prepared. There is an interesting note referring to Diego Garcia, the most southerly island of the Chagos Archipelago, and others on Mr. Colquhoun's expedition through Southern China and Burmah, and the journey of MM. Bouvalot and Capus from Bokhara to Krasnovodsk. The full text is also given of Lieut. A. W. Greely's report on the proceedings of the expedition to Fort Conger, Grinnell Land, the name he has given to the first of the international meteorological observatories in the Polar area.

THE Geographical Society have now ready for issue by Mr. Murray, Mr. E. Colborne Baber's "Travels and Researches in Western China," forming the first part of their *Supplementary Papers*, a publication which is to take the place of their annual *Journal*. The staple of the volume consists of Mr. Baber's journey of exploration in Western Szechuen, accompanied by various scientific observations and tables of latitudes and longitudes of numerous positions. The remainder of the volume contains reprints of a brief narrative of a journey to Ta-chien-tu, and notes on the route of the Grosvenor mission through Western Yünnan and on the Chinese tea-trade with Tibet. The maps are of great value, and consist of one showing the distribution of the Sifan tribes, a section of country along Mr. Baber's routes, and a large route-map of his explorations in Western China.

THE two last numbers of the *Izvestia* of the Russian Geographical Society contain a good deal of valuable information. M. Pevtsoff contributes a paper on his journeys in Mongolia, from the Altai to Kobdo, Kukukhoto, Kalgan, and back, *viâ* Urga and Ulasutai, with a map of the country; Dr. A. Woeikoff gives a *résumé* of the amount of cloud, observed during ten years' observations in Russian meteorological stations; A. E. Regel contributes a paper on his journey to Turfan in 1879; Lieut. Kalitin gives a description of the region explored between Akhalteke and Khiva, with a map; and MM. Yadrintseff gives an interesting account of the Tartars of Altai. There are, besides, a letter of A. W. Adrianoff, on his expedition in the Kuznetsk region, a list of heights determined by M. Potanin in Mongolia, information about the expedition of the *Jeannette*, of the *Alliance*, of the *Thomas Corvin*, and other small notices.

THE Russian Geographical Society is taking part in an expedition to Central Africa, under the leadership of M. Schultze-Ragozinsky, and with the participation of M. Bianchi, Prof. Licati, M. Budilovitch, of the Russian navy, M. Bartoshevitch, of the St. Petersburg University, M. Tomsen, Windakovitch, and several others. The expedition proposes to explore the little-known parts of Equatorial Africa, between 1° and 10° N. lat., and 10° to 12° E. long. The expenses will be defrayed from a special fund subscribed by the members of the expedition, and amounting to 10,000*l*.

WITH the beginning of the present year the Geographical Society of Paris have begun to issue a fortnightly *Compte Rendu* of their proceedings, published within ten days after their meetings. A quarterly volume will also be issued containing memoirs and other papers of some length. This is a great improvement on the old *Bulletin*, which was often months behind date. The Society now numbers upwards of 2150 members.

WE may remind our readers that Mr. Edmund O'Donovan, so well known as the *Daily News* correspondent in the Trans-Caspian region, and more particularly at Merv, will read a paper before the Geographical Society, on March 27, on the geography of Merv and the surrounding country. The meeting will, we believe, be held as usual in the theatre of London University, at Burlington House.

AT the last meeting of the Geographical Society of Paris, M. Achille Raffray, Vice-Consul at Massowah, read an interesting paper on his journey in Abyssinia, and in the country of the Raya Gallas. It was announced during the evening, that one of the Society's gold medals had been awarded to M. G. Revoil, for his journeys in Somali-land, and another to Dr. Lenz, for his recent journey to Timbuktoo, the Logerdt prize medal to Dr. Montano, for his explorations in the Malayan Archipelago, and the new Jomard prize to Prof. Gaffarel, for his services in the cause of historical geography.

DIRECT news from Lieut. Bove, the leader of the Italian Antarctic expedition which started from Buenos Ayres, has been received in Italy. The expedition was most hospitably received at Buenos Ayres. The Government of the Argentine Republic has sent out a commission with the Italian Expedition for the purpose of carefully revising the survey of the coast of their country; thus the expedition now consists of four ships, viz. *Santa Cruz*, *Uruguay*, *Cape Horn*, and a steam barque. The *Cape Horn* is the largest vessel, and will proceed to the Antarctic regions, while the *Uruguay* will remain at Cape Horn. The *Santa Cruz* will attend to the coast survey. The expedition started on November 8, and Lieut. Bove hoped to leave Cape Horn by the end of December in order to sail across to South Shetland and Grahamsland. He hoped to be back at Tierra del Fuego by the end of March, to stay there till May, and then to leave for Buenos Ayres.

ON THE ELECTROLYSIS OF SULPHATE OF COPPER[1]

THE immediate object of this research was to examine various conditions connected with the transmission of electric currents through solutions of salts of copper, and to ascertain the influence of those conditions on the electro-chemical equivalent of copper, also to observe for any signs of conduction of electric currents by such liquids without electrolysis. In many of the experiments some difficulty was experienced in ascertaining the exact loss of weight of the anode, in consequence of finely-divided copper falling from it. The powder which fell off, exposing as it did a large surface to the liquid, was somewhat oxidised, and also in acid solutions freely dissolved, and its true weight, and therefore the exact loss of the anode could not be found.

Amongst the results obtained were the following:—that a porous partition in a solution of sulphate of copper affected the deposit only by preventing the products set free at the two electrodes becoming mixed together; a large surface of cathode diminished the amount of deposited metal, by allowing more copper to be re-dissolved by ordinary chemical action; the effect of diluting the liquid with sulphuric acid was to slightly diminish the amount of deposited copper; diluting the solution either with water, glycerine, propionic acid, solution of sulphate of sodium, borax, boracic acid, or of ammonic alum, had very little effect (and that variable) upon the amount of deposit; much less copper is deposited per unit of current in a hot liquid than in a cold one; without the influence of an electric current, a copper plate dissolved fifty-six times faster in an ordinary depositing solution of sulphate of copper at 180° F. than at 50 F.; the amount of copper deposited by aid of a current in such a liquid at 50° F. was about 18 per cent. greater than at 180° F.; with an electric current of small density, and a sufficiently corrosive liquid containing a very small amount of dissolved copper, no deposition of copper takes place; instead of an electric current protecting a copper cathode from chemical corrosion, it indirectly increases that corrosion; a sufficient rise of temperature (viz. from 50 F. to 180° F.) was nearly twice as influential as the electric current in increasing purely chemical corrosion; the purely chemical corrosion of a copper anode in ordinary sulphate of copper-depositing solution, is less than that of a separate piece of copper without a current; the loss of the anode is greater than the gain of the cathode in nearly every instance, and this difference is slightly greater with near electrodes than with distant ones; reduction of temperature is a most influential circumstance in diminishing the chemical corrosion of the two electrodes, and making their alterations of weight, by electrolytic action, approximate to each other; purely chemical corrosion of the copper is not entirely prevented by using a pure and cold solution not containing any free acid; the inequalities of loss and gain of the two electrodes are largely, if not wholly, due to purely chemical action; there exist relative degrees of chemical corrosive power and strength of current, at which the influence of the two are equal, and a copper cathode neither dissolves nor receives a deposit in an acidulated solution of sulphate of copper containing a very small amount of dissolved copper salt; the amount of copper deposited is not sensibly affected by the presence of a small amount of green sulphate of iron in the solution; nor by the exposure of such a solution freely to the air or to the light; differences of relative position of the electrodes to each other affect slightly both the amount of total loss of the anode per unit of current, and also the relative amount of such loss to the amount of gain of the cathode; the presence of a considerable quantity of persulphate of iron in the solution affects perceptibly the amount of deposited copper, but that of a moderate proportion of nitrate of copper in the solution had no conspicuous effect of the kind; the chemical corrosion of sheets of copper in pure acidulated solution of sulphate of copper was not directly proportionate to their amount of surface, but was relatively less upon the larger surface; the amount of copper deposited per unit of current did not vary much with the magnitude of the cathode or the density of the current; a very feeble thermo-electric current caused a cold copper anode to lose a little more, and a hot cathode to lose slightly less, than without the current; stirring the solution increased slightly the loss of weight of the anode per unit of current, and diminished to a small extent the gain of the cathode; stirring a pure acidulated solution of sulphate of copper increased the proportion of loss of weight of copper by ordinary chemical corrosion without an electric current from ·07 grain to ·17 grain, or from ·411 to 1·0, but in a less proportion if a current was entering the copper as a cathode; a considerable degree of density of current appears to be favourable to enabling a nearer approximation to be made to the true electro-chemical equivalent in the weight obtained of deposited copper.

Many of the experiments indicate, and the whole of them are consistent with the general inference, that in nearly all cases of electrolysis, the two forces, ordinary chemical and electro-chemical, coexist and operate independently at the same surfaces of liquid and metal; that ordinary chemical action, both of simple oxidation and of corrosion of both electrodes by free acid, takes place in all cases, and is a phenomenon essentially distinct from, and independent of, electro-chemical corrosion of the anode, and deposition upon the cathode. The two classes of phenomena, however, are coincident, and affect each other in various indirect and secondary ways.

In consequence of these two actions being essentially distinct and independent of each other, an electric current passing out of a piece of copper into an acid solution does not directly increase the rapidity of ordinary chemical corrosion of the metal, nor does a current entering from such a liquid into a copper cathode, protect in all cases that metal from such corrosion.

Some of the experiments show that stirring the liquid increases the ordinary chemical corrosion both of the anode and of the cathode, and therefore that the technical process of swaying to and fro by mechanical means, articles which are being plated in a depositing solution, tends to corrode them.

That temperature also greatly influences the chemical corrosion is proved by the numerical results. The higher the temperature the greater was the amount of chemical solution of the hot copper without current, and of the hot electrodes; and for equal rise of temperature, the increase of corrosion appeared to be

[1] Abstract of a paper read before the Birmingham Philosophical Society, January 26, 1882. By G. Gore, LL.D., F.R.S.

greater at high temperatures than at low ones, because the corrosion itself produced heat.

A considerable deficiency of deposited copper, sometimes amounting to 18 per cent., may result by ordinary chemical corrosion through employing a hot solution. This fact is worthy of consideration in the electro deposition of copper for commercial purposes.

The greatest obstacle to finding the electro-chemical equivalent of copper was the difficulty of determining how much the ordinary chemical corrosion was decreased at the anode or increased at the cathode by the electric current, and the next greatest obstacle was the disintegration of the anode, and the dissolving of the powder by chemical action. Notwithstanding that the cathode is more corroded by purely chemical action than the anode, the gain of weight of the former is the least inaccurate, because of the unavoidable disintegration of the anode. Substantially the method does not admit of a great degree of accuracy, because the chemical corrosion of copper, even in a cold neutral solution of cupric sulphate, causes a loss of that metal, and prevents the true weight being obtained. The correction cannot be accurately, but may be approximately, found, by using a comparison sheet of copper in the same liquid without a current. The corrosion of such a sheet is, however, somewhat less than that of the cathode. The nearest approach to the true number appears to be obtained by using a cold neutral solution, small narrow horizontal electrodes, and rapid deposition without stirring, continued during only a short period of time.

No signs were observed in any of the experiments of ordinary electric conduction unattended by electrolysis.

The results of this research also afford information respecting the degree of accuracy of the method of measuring by means of electrolysis of a solution of cupric sulphate, the amount of electric current consumed in electric lighting, and states the conditions under which the degree of inaccuracy of such a method of measurement is the least. It is a remarkable circumstance that an electric current entering a copper cathode from a strong mixture of sulphuric acid and water, instead of protecting the copper, actually increases its chemical corrosion; by what means it does this is now being investigated by the author.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The examiners for the Burdett-Coutts Geological Scholarship have recommended for election Mr. G. A. Buckmaster, B.A., of Magdalen College. Mr. R. Chalmers, B.A., of Oriel, also distinguished himself in the examination. The scholarship is tenable for two years.

CAMBRIDGE.—Notice has been given that one of the Cambridge local examinations will be held in September next, commencing on Monday, 4. This is, partly, for the convenience of students who desire to pass a preliminary examination required by the General Medical Council previous to registration as medical students. Many students used to resort to the College of Surgeons for this purpose, but the College has ceased to hold such an examination, and it is at the instance of the Medical Council that a local examination is to be held in September for the accommodation of the medical students. The examination is also intended to enable students who intend entering the University in October to obtain, before going up to Cambridge, the certificates which will excuse them from the previous examination of the University. They will find it a considerable advantage to do this, for, in addition to the time so gained, having gone through the required test of school education through the local examination in September, they will be able at the beginning of the October term to join the classes of the several professors (of natural science, medicine, and others) at the commencement of the several courses. Hitherto many passed the previous examination in December, and many at a later period. Now the arrangements are such that all have the opportunity, through the Oxford and Cambridge Schools Board Examination in June, or through the local examination in September, of obtaining certificates which will wholly, or partly, exempt them from the previous examination; and it is obvious that those who take the advantage of this opportunity will have the start of their fellows in the University race. The September examination will be held on September 4, in Cambridge and London, and other places in which there may be sufficient candidates. The requisite forms to be filled up and sent in before August 1, may be obtained, with other information, for Cambridge, from Rev. G. F. Browne, St. Katharine's College; and for London, from Mr. R. Sc. J. Corbet, 10, Portman Street, London, W.

PROF. HUMPHRY announces that Mr. Donald McAlister will give a course of lectures on the Mechanics of the Human Skeleton in the Easter Term, beginning on Wednesday, April 26.

THE Cambridge University Natural Science Club celebrated the tenth anniversary of their foundation by holding a dinner in the hall of Downing College (kindly granted for the occasion) on March 11. Dr. Michael Foster, Sec.R.S., occupied the chair, and there was a large gathering of old and present members and their friends. It is worthy of note that seven Professorial chairs in science and ten Fellowships, besides other dignities, are at present occupied by former members of the Club in the short time that has existed since its foundation.

VICTORIA UNIVERSITY.—The Council have appointed the following as external examiners of the University:—In Classics, the Rev. R. Burn, M.A., Fellow of Trinity College, Cambridge; In English Language and Literature, Mr. T. C. Snow, M.A., Fellow of St. John's College, Oxford; in French, M. E. Joël, Mason College, Birmingham; in German, Prof. C. A. Buchheim; in Philosophy, Mr. James Sully, M.A.; in Political Economy, Mr. W. H. Brewer, M.A.; in Mathematics, Mr. John Hopkinson, M.A., D.Sc., F.R.S.; in Engineering, Mr. John Hopkinson, M.A., D.Sc., F.R.S.; in Physics, Prof. A. W. Rucker, M.A.; in Chemistry, Prof. H. E. Armstrong, F.R.S.; in Physiology, Mr. J. Langley, M.A., Fellow of Trinity College, Cambridge; in Zoology, Mr. Patrick Geddes, Demonstrator in Botany in the University of Edinburgh; in Botany, Mr. S. H. Vines, M.A., D.Sc., Fellow of Christ's College, Cambridge; in Geology and Palæontology, Prof. T. Rupert Jones, F.R.S.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, February 12.—Prof. W. Flower, LL.D., F.R.S., president, in the chair.—Mr. F. Moore read a paper containing an account of the Lepidoptera collected by the Rev. J. H. Hocking, chiefly in the Kangra district, North-west Himalaya, with descriptions of new genera and species.—A communication was read from Mr. G. A. Boulenger, C.M.Z.S., in which he gave the description of a Frog (*Phyllomedusa hypochondrialis*) lately living in the Society's Gardens. This Frog had been obtained at Pernambuco, and was believed to be the first example of the species that had reached Europe alive. Attention was drawn to the peculiar coloration, as being worthy of notice, it not having been described before.—Mr. Oldfield Thomas read a paper containing the descriptions of a small collection of Rodents which had been obtained by the late Mr. B. J. Andersson in Damara Land and in the neighbouring countries. The collection contained examples of a new species of Mouse, which was proposed to be named *Mus nigricauda*.—Mr. W. A. Forbes gave a description of the pterylosis of *Mesites*, and made some remarks on the position of that genus, which he considered to be most nearly allied to *Rhinochetus* and *Eurypyga*, though all these three forms should be referred to different families.—Prof. St. George Mivart read a series of notes on the anatomy of the Canada Porcupine (*Erithizon dorsatus*).

Chemical Society, March 2.—Prof. Roscoe, president, in the chair.—The following papers were read:—On the action of aldehydes on phenanthraquinone in presence of ammonia (third notice), by F. R. Japp and F. W. Streatfeild. With aldehydes of the benzene series and furfuraldehyde, compounds belonging to the class of substances obtained by Ladenburg (*Ber.* ix. 1524) were obtained; with hydroxyaldehydes of the benzene series, compounds of the character of the anhydrobases described by Hübner were formed; with the methyl ether of salicylaldehyde a mixture of both the above bodies is obtained. The authors conclude that the above reactions are most readily accounted for on the assumption that phenanthraquinone has the peroxide constitution ascribed to it by Graebe.—Application of the aldehyde and ammonia reaction in determining the constitution of quinones, by F. R. Japp and F. W. Streatfeild. The authors state that the occurrence of this reaction and the formation of compounds resembling those above described, may be taken as a proof of the ortho position in quinones.—On the solubility of glass in certain reagents, by R. Cowper. The author has determined the quantity of matter dissolved out of glass by ammonium sulphide and ammonium hydrate; dilute solutions have more action than the concentrated reagents.—Analysis of a piece of oxidised iron from the condenser of H.M.S. *Spartan*, by R. Cowper. This contained no metallic iron, but 42·33 per cent. of ferrous oxide, 2·21 per cent. of ferric oxide, 5·24 per cent. phosphoric acid, 2 per cent. chlorine, and 16·71 per cent. water. Under ordinary circumstances iron rust is chiefly composed of ferric oxide.—On the action of sodium hydrate and carbonate on felspars and Wollastonite, by W. Flight. The hydrate acts powerfully as a solvent, but the strongest solutions of the carbonate have but little action.—On the preparation of pure nitrogen, by W. Flight. The author finds that ferrous oxide, freshly precipitated by adding caustic potash to ferrous sulphate solution, completely deprives ordinary air of oxygen; potassium pyrogallate and other reagents do not remove the last traces of oxygen.—Some observations on the luminous incomplete combustion of ether and other organic substances, by W. H. Perkin. When, in the dark, a jet of ether is blown from a wash-bottle on to an iron plate at a dull red heat, a lambent blue flame is observed, the temperature of which is so low that it does not char paper; a similar flame is seen when a heated iron ball is suspended over a dish of ether. Sir H. Davy, Doebereiner, and Boutigny, have noticed this phenomenon. Spermaceti, when melted over a hot iron ball shows a similar phenomenon. Paraffin, alcohol, &c., also give a blue flame when treated as above.

Mathematical Society, March 9.—S. Roberts, F.R.S., president, in the chair.—Mr. A. Buchheim, B.A., Scholar of New College, Oxford, was elected a Member.—The following communications were made:—In how many ways can a polygon of $2n$ sides be divided into quadrilaterals by means of non-intersecting diagonals with an extension to the general case of division into p-gons? Prof. Rowe.—Systems of formulæ for the sn, cn, dn of $u+v+w$, Prof. W. Woolsey Johnson (communicated by J. W. L. Glaisher, F.R.S.).—Remarks on the preceding paper, and on elliptic function formulæ, Rev. M. M. U. Wilkinson.—Two notes, Mr. C. E. Bickmore.—Note of proofs of the addition theorem for the second integral, and Fagnani's theorem by confocal conics, J. J. Walker.

Linnean Society, March 2.—Sir J. Lubbock, Bart., F.R.S., in the chair.—The following gentlemen were elected Fellows of the Society, viz.:—Col. R. H. Beddome, T. B. Chambers, Rev. W. H. Dallinger, C. D. Ekman, W. Fream, Rev. R. Hooper, C. Dubois Larbalestier, Rev. R. P. Murray, and R. Vipan.—Prof. P. M. Duncan showed an example of the pollen-tube of *Crocus sativa*, and he explained his views thereon.—Mr. Chas. Stewart also exhibited sections of the ovule of *Crocus*, and Mr. C. Fred. White likewise exhibited a series of drawings of the pollen of various plants.—D. T. Spencer Cobbold called attention to drawings of the pollen-tubes of *Portulaca oleracea*, &c., received from Mr. Krutschnitt, of New Orleans, U.S.—A paper on the structure and habits of the coal-reef annelid *Palolo viridis*, by the Rev. Thomas Powell, was read; the information regarding its periodic visits to Samoa and Fiti being of considerable interest.—Contributions to the Lichenographia of New South Wales, by Chas. Knight, was also read, some fifty new species of Lichens being described.—Mr. A. G. Butler gave a communication on the butterflies collected by Lord Walsingham in California; and Mr. R. B. Sharpes' seventh contribution to the ornithology of New Guinea, and a description of a new species of sand-martin (*Cotile*) from Madagascar, were read.—There followed a description of a new genus (*Microgale*), and two new species of Insectivora from Madagascar, by Mr. Oldfield Thomas.

Anthropological Institute, February 21.—Edward B. Tylor, F.R.S., vice-president, in the chair.—The election of W. Crowder was announced.—Mr. J. E. Price read a note on Aggri beads. These beads are occasionally dug up on the Gold Coast, and sell for more than their weight in gold, being among the most valued of royal jewels. They have been found in various parts of England, some of those exhibited having been obtained from Colchester, where they were found associated with human remains, whilst others were discovered during the recent alterations at Leadenhall Market. The author thought that the appearance of these beads in England might be accounted for by the fact, that when the Romans occupied the country they brought with them many African slaves who wore necklaces with Aggri beads attached, and that when these slaves died their necklaces were buried with them.—Dr. Macfarlane read a paper on the analysis of the relationships of consanguinity and marriage; and in the absence of the authors the director read a paper entitled from Mother-right to Father-right, by Mr. A. W. Howitt and the Rev. Lorimer Fison.

Geological Society, February 22.—J. W. Hulke, F.R.S., president, in the chair.—Richard Kerr, Baron Ferd. von Müller, K.C.M.G., M.D., Ph.D., F.R.S., William Whitehead Watts, and Joseph Wilkinson, were elected Fellows of the Society.—The following communications were read:—Additional discoveries of high-level marine drifts in North Wales, with remarks on driftless areas, by D. Mackintosh, F.G.S.—On some sections of Lincolnshire Neocomian, by H. Keeping, of the Woodwardian Museum, Cambridge, communicated by W. Keeping, F.G.S.—Notes on the geology of the Cheviot Hills (English side), by C. T. Clough, F.G.S.

Physical Society, March 11.—Prof. Fuller in the chair.—New Member, Mr. D. Reece Jones.—Mr. Newth showed some experiments illustrative of the fact announced by M. Mascart in 1875, that solid particles in the air are necessary to the formation of fogs; and secondly, that certain gases, such as sulphurous acid gas, also cause fogs in the same way, by permitting the moisture to condense upon these particles. The experiments consisted in passing an electric light beam through large bulbs of glass containing air and a small quantity of water. When the air in the bulbs was washed with the water, and thus freed from motes, the fog produced in the bulb by slightly exhausting it with an air-pump was much less than when the air of the room, or smoke, or sulphurous acid gas, was admitted into the bulb. The dust on a platinum wire, rendered incandescent within the globe by an electric current, also caused a sensible fog. It follows that with gas fires instead of coal, there would still be fogs, though not so black ones.—Prof. F. Guthrie, F.R.S., read a paper on the discharge of electricity by heat. This was concerned with additional experiments to those made by the author on the subject nine years ago. He showed by means of a gold leaf electroscope that a red-hot iron ball, when highly heated, would neither discharge the positive prime conductor of a glass electrical machine nor the negative one, but on cooling the ball a temperature was found at which the ball discharged the negative conductor, but not the positive one. Lastly, on cooling the ball still further (but not below a glowing temperature) it was found to discharge both positive and negative electricity. A platinum wire rendered red hot by the current also discharged a negatively-charged electroscope more readily than a positively charged one. When placed between two electroscopes, one having a + and the other a − charge, it discharged neither. When the + one was withdrawn the − was discharged; but when the − was withdrawn the + was not discharged. There therefore seemed a tendency in a hot body to throw out + rather than − electricity. That a material medium between the heated body and the electrified one was necessary, was shown by the failure of the experiment with a Maxim incandescent lamp consisting of a carbon filament in a vacuous bulb. Dr. Guthrie also showed the demagnetisation of a small magnet in the heat of a Bunsen flame by inserting it in a coil of wire connected to a mirror galvanometer and heating it in the flame. He also showed that the pole of a voltaic battery could be discharged by heating it red hot. This was done by connecting a piece of fine platinum wire to one pole and heating it in the flame of a spirit lamp, care being taken to insulate the lamp to prevent conduction to earth. The discharge was shown by means of a mirror electrometer.

Entomological Society, March 1.—Mr. H. T. Stainton, F.R.S., president, in the chair.—Mr. T. R. Billups exhibited queens of *Vespa germanica*, taken on the wing on January last, and specimens of *Callistus lunatus* and *Ichneumon erythræus*.—Mr. R. McLachlan showed papers in which butterflies had been received from Borneo, bearing an unusually distinct imprint of the inclosed insect.—Messrs. Meldola and Cowan called attention to the assembling of butterflies round pupæ.—Mr. E. A. Fitch exhibited some eggs of Entozoa.—Papers read:—Mr. C. O. Waterhouse, a description of *Paramellon sociale*, a new genus and species of Myrmecophilous Coleopteron from India.—Dr. D. Sharp, on some New Zealand *Coleoptera*.—Mr. A. G. Butler, additional notes on *Bombyces* collected in Chili by Mr. T. Edmonds.—Mr. E. Saunders on the abdominal segments in aculeate *Hymenoptera*, and Sir S. S. Saunders on those in the *Chalcididæ*.

EDINBURGH

Royal Society, February 20.—Prof. Maclagan, vice-president, in the chair.—Prof. Turner read a paper on a specimen of *Balænoptera borealis* or *laticeps*, which was captured in 1872 at Boness, on the Firth of Forth. Comparing this species with the other three species of Balænoptera, the author noted how highly characteristic of each were the number of vertebræ and the appearance of the whalebone. The skull, ribs, and other bones of the present specimen were of a peculiarly smooth texture as compared, for example, with those of *Balænoptera Sibbaldii*—indicating probably a less amount of oil in the bones of the former. The hyoid bone was particularly referred to as of a highly characteristic form.—Prof. Tait communicated a quaternion note by M. Gustav Plarr, on Minding's theorem.—Prof. Heddle presented chapter vii. of his chapters on the mineralogy of Scotland, dealing in the present instance with the ores of manganese, iron, chromium, and titanium. Two new ores of iron were described.—Prof. Tait communicated a paper by Mr. W. J. Millar, C.E., on the dimensions of cast iron at various temperatures, the greatest novelty in which seemed to be the conclusion, based on careful experiment, that the coefficient of linear dilatation of iron diminishes markedly with rise of temperature.—Mr. M. M. Pattison Muir, M.A., in a short chemical note, gave the properties of an oxycyanide of bismuth, and recorded the discovery of a new oxide, which he called the hypobismuthic oxide.—Mr. T. B. Sprague communicated an extremely neat and complete graphical representation of the well-known theorem, due to Cauchy, relating to the number of roots in an equation of the *n*th degree.—Dr. R. S. Marsden supplemented his former communication on the function of carbon in steel by a short paper on the influence of silicon (which behaves somewhat similarly to carbon), phosphorus, manganese, and other elements.

PARIS

Academy of Sciences, March 6.—M. Blanchard in the chair.—The following papers were read:—On the normal carbonic acid of atmospheric air, by M. Dumas. After noticing the defects of several methods of measurement, he commends the exactness of M. Reiset's, and accepts his result, that about 3 vol. in 10,000 represents the general (little varying) ratio of CO_2 in air. The variations through great movements of the atmosphere now require study, by observers placed at many different and distant stations, and the transit expeditions should keep this in view. MM. Müntz and Aubin's methods are most suitable for this.—On some applications of the theory of elliptic functions, by M. Hermite.—Experiments on a Faure secondary battery, by MM. Allard, Le Blanc, Jaubert, Potier, and Tresca. The charging of the battery (formed of thirty-five elements, new model) required a total mechanical work of 1558 horse-power during 22h. 45m., or 1 horse-power during 35h. 26m. The battery really received only 0·66 of this work. 60 per cent. of the work of 6,382,100 kgm. thus stored was recovered in discharge (Maxim lamps being used). The use of the accumulator thus cost 0·40 of the work furnished by the dynamo. This loss would in many cases be outweighed by advantages.—On the double decompositions of haloid salts of mercury by hydracids and by haloid salts of potassium, by M. Berthelot.—On the formation of two dibasic acids, sebacic and suberic, in distillation of crude fatty acids by means of a current of superheated steam, by MM. Cahors and Demarçay.—Experimental studies on the action of permanganate of potash on poisons, forms of virus, and zymotic diseases, by M. Vulpian. The method can only be efficacious, he thinks, when the bite is very recent; in one hour, or more it must be useless, the permanganate (in the dose recommended) being unable to overtake the poison, and being soon decomposed. Intravenous injection of an efficacious dose of permanganate would be fatal.—Memoir on the generation and regeneration of the bone of caducous and persistent horns of Ruminants, by MM. Robin and Herrmann. They controvert the view that in the present case there is an exceptional form of osteogenesis, viz. *metaplastic* ossification, or direct transformation of cartilage into bone.—New pump for compression of gases, by M. Cailletet. A special feature is the presence of mercury above a plunger piston, with which the mercury moves. An hour's work will give 400 or 500 gr. of liquid carbonic acid or protoxide of nitrogen. The author stores compressed gases in bundles of metallic tubes communicating with each other, and each holding about four litres. Pressures of several hundred atmospheres are attained. The movement of the mercury in the pump counteracts heating.—Quick method of determining the density of gases, by M. Chancel. This depends (like M. Dumas' method for vapours) on displacement of the air of a spherical glass vessel by the gas whose density is to be measured, and which enters by a lateral tubulure in the neck, passing thence down a bent tube (soldered to the hollow stopper), which opens near the bottom of the vessel. At the proper time the stopper is turned, the supply tube (caoutchouc) detached, a cock above the stopper closed, and the vessel weighed.—M. Villarceau made some remarks in presenting a memoir on the methods of Wronski in celestial mechanics.—On rules to be followed in hypnotisation of hysterical persons, by MM. Dumontpallier and Magnin. This relates to the ways of producing each of the periods of hypnotism. To make a state disappear, one should use the same agent as produced it.—On the determination of the genus of an entire transcendental function, by M. Laguerre.—On the law of deviation of Foucault's pendulum, by M. Hatt.—On the compressibility of gases, by M. Sarran. He seeks to verify a relation given by Clausius, for other gases than carbonic acid.—On a vibratory movement in production of a steam jet, by M. Vautier. A plate placed across the jet at a certain height is repelled; but if lowered parallel to itself, it is attracted, and at about 0·2 mm. from the orifice it oscillates, with sound.—Hydrodynamic experiments (third note); direct imitation, with liquid currents, of the actions of electric currents on each other, by M. Decharme.—On the retrogradation produced by the electric *effluve* in transformation of oxygen into ozone, by MM. Hautefeuille and Chappuis. This change of ozone into oxygen is due to liberation of heat, accompanying the spontaneous destruction of ozone raised to a high temperature by the effluve; it occurs only at low pressures of oxygen.—On some phosphates neutral to litmus, by MM. Filhol and Lenderens.—On an isomer of orcine, lutorcine, by MM. Vogt and Henninger.—On the soluble and insoluble modifications of the ferment of gastric digestion, by M. Gautier.—Division of embryonal cells in Vertebrates, by M. Henneguy. These observations were on the ova of trout.—On the circulatory apparatus of starfishes, by MM. E. and J. Perrier.—On some types of Cestodes, by M. Moniez.—On the organisation of the mouth of *Dochmius* or *Ankylostomas*, *apropos* of parasites of these two genera found in the dog, by M. Magnin.—Diabetic endocarditis, by M. Lecorché.—Ophitic rocks in the Pyrenees; ages; relations with saliferous substances; origin, by M. Dieulafait.—Variations of temperature with altitude in the valley of the Seine during the period of high pressures in January, by MM. Lemoine and de Tréandeau.—A geological map of the Loire valley (scale $\frac{1}{40000}$), by M. Grüner, was presented.

CONTENTS